



Disruptive Technology: An Uncertain Future

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21 May 2005

***Director of Plans & Programs
Defense Research and Engineering***

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Future Battlespace



"Innovation within the armed forces will rest on experimentation with new approaches to warfare, strengthening joint operations, exploiting U.S. intelligence advantages, and taking full advantage of science and technology....."

The National Security Strategy of the United States, September 2002

Definition of Disruptive Technology

The Textbook Definition



- **Harvard Professor, Clayton Christensen*** described disruptive technologies as a lower-performance (but cheaper) new product that can be improved more rapidly, so that performance outpaces the product it is replacing
- **Key concepts:**
 - Greater performance than previous product
 - Replaces (drives) old product out of market

* *"The Innovator's Dilemma", 1997*

Disruptive Technology

The Non-Textbook Definition



- For Defense systems, lower cost and lower initial performance does not matter
- What matters is rapid evolution from old, stable technology to new, dominating technology
- A technology surprise that gives a competitor an advantage
 - Business - Technology that overturns market
 - Military - Technology that causes a fundamental change in force structure, basing, and capability balance
- Disruptive Technologies may arise from systems or enabling technology

Definition of Disruptive Technology

Some Historical Examples--Commercial



Candle



Electric Light

Vacuum Tubes



Transistors

Mechanical Watches

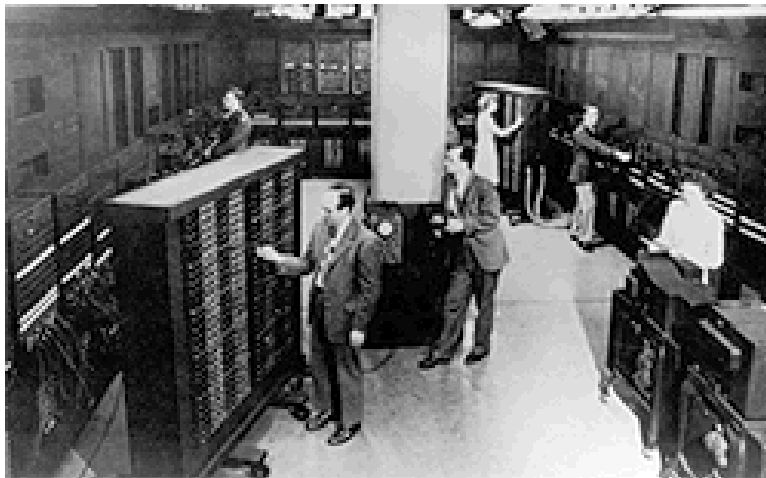


Quartz Watches

Mainframe Computers



Personal Computers



In each case, the disruptive technology decimated the conventional market - in a very short time

Definition of Disruptive Technology

Some Historical Examples--Military



Spotter	→	Radar
Bombers	→	ICBMs
Horse Drawn Artillery	→	Armored Howitzers
Flares	→	Night Vision Goggles



**In Each Case, the Disruptive
Technology Changed the Force Structure**



A Focus on Revolutionary Advances

Stealth



Night Vision



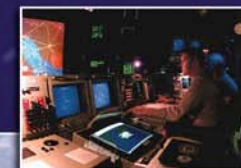
Adaptive Optics and Lasers



GPS



Phased Array Radar



Definition of Disruptive Technology

Extended to the DoD



- **For Military Application, a Disruptive Technology may be offensive, defensive, or “spin-off”**
 - **Offensive - A capability developed to provide a “transformational” new capability**
 - **Defensive - A capability developed in response to someone else’s advantage**
 - **Unintended - A capability developed for commercial....but with military applications**

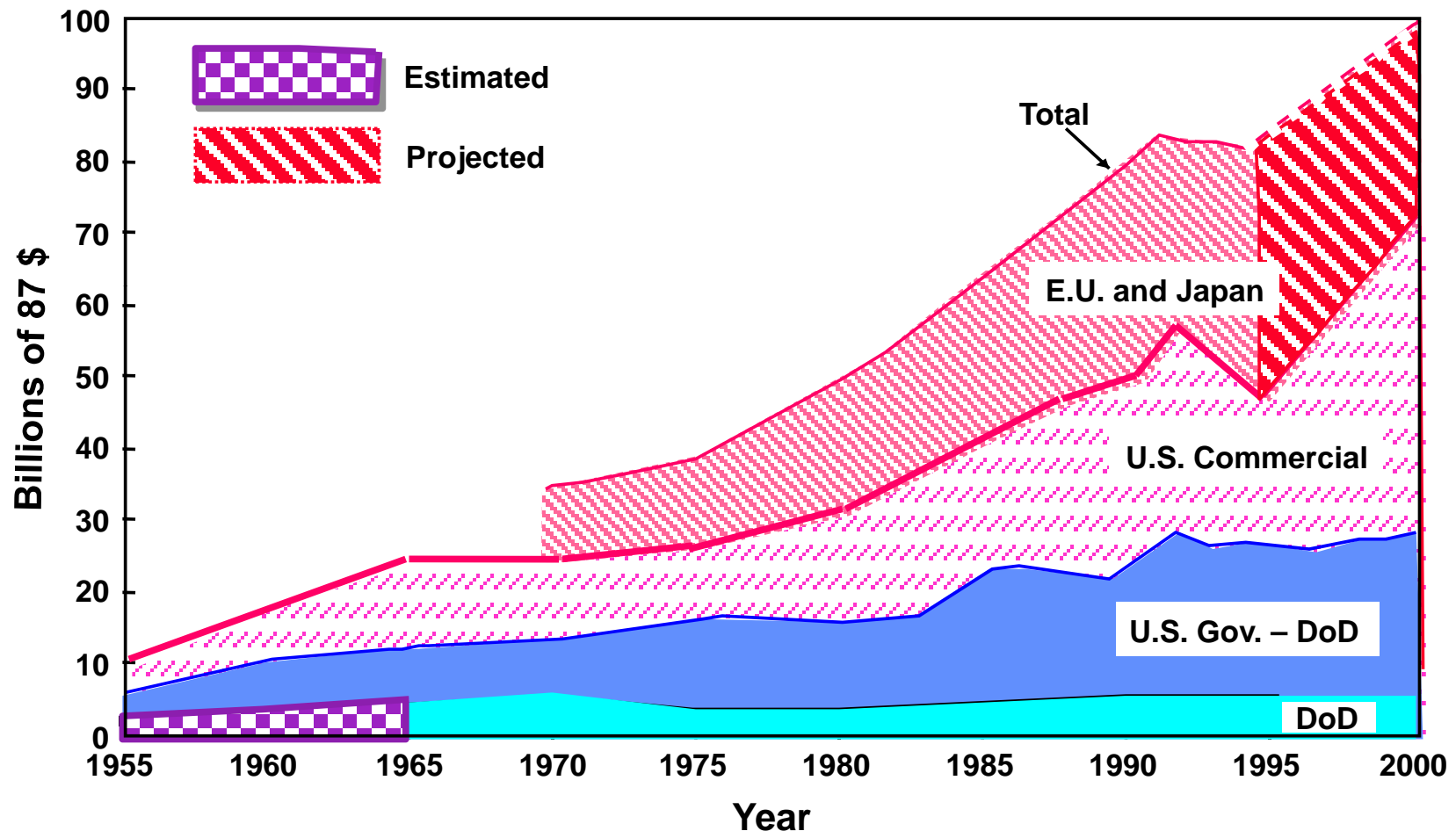
Disruptive Technologies

Frequently Take a Forcing Function



Technology	Approximate Date Of First Lab Demo	Approximate Date of First Military Applications
Radio	1901	1914
Airplane	1903	1916
Vacuum Tube	1906	1915
Mechanized Tank	1916	1916
World War I		
Liquid-Fueled Rockets	1922	1944
Radar*	1925	1939
Gas Turbine*	1935	1944
Digital Computer*	1943	1945
Ballistic Missile*	1944	1945
Nuclear Weapons*	1945	1945
World War II		
Transistor*	1948	1957
Inertial Navigation*	1950	1955
Nuclear Propulsion*	1950	1954
Artificial Earth Satellites*	1957	1960
Integrated Circuit*	1960	1970
Laser*	1961	1967
Precision Weapons*	1965	1967
AI Expert System*	1965	1990
Cold War		

U.S. and Worldwide Research Base Since WWII



Source: Report of the Defense Science Board Task Force on the Technology Capabilities of Non-DoD Providers; June 2000; Data provided by the Organization for Economic Cooperation and Development & National Science Foundation

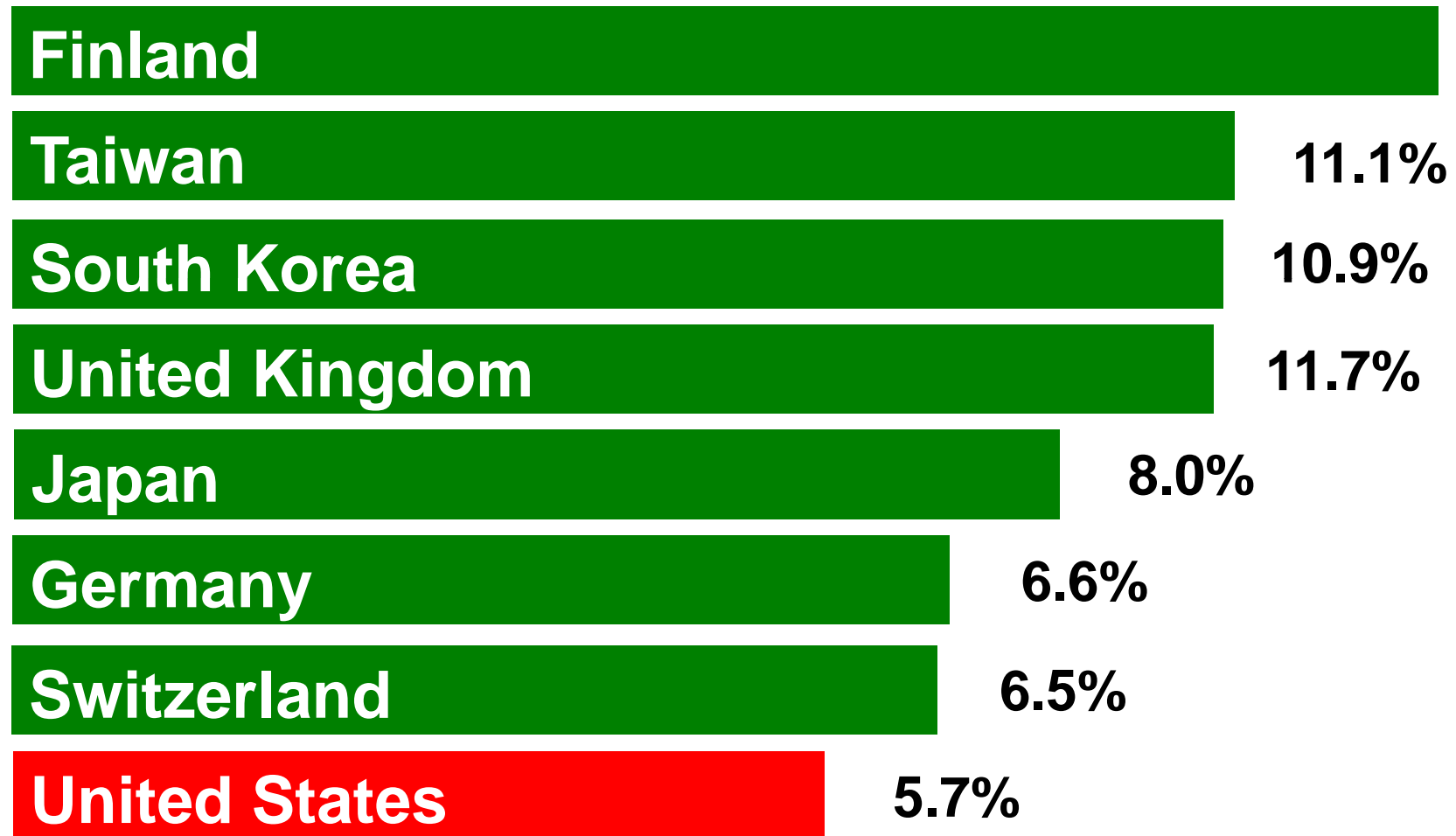


A National Issue

- “An Emerging and Critical Problem of the Science and Engineering Workforce”¹
 - 12 Major studies (1999-2004) make essentially the same point
 - A few studies did not consider security clearance needs and rely on relaxation of immigration rules
- Growing need for U.S. citizens in national security activities

1. National Science Board Companion Paper to “National Science and Engineering Indicators 2004”, National Science Foundation, April 2004

Percentage of 24-year-olds with a Science or Engineering Degree



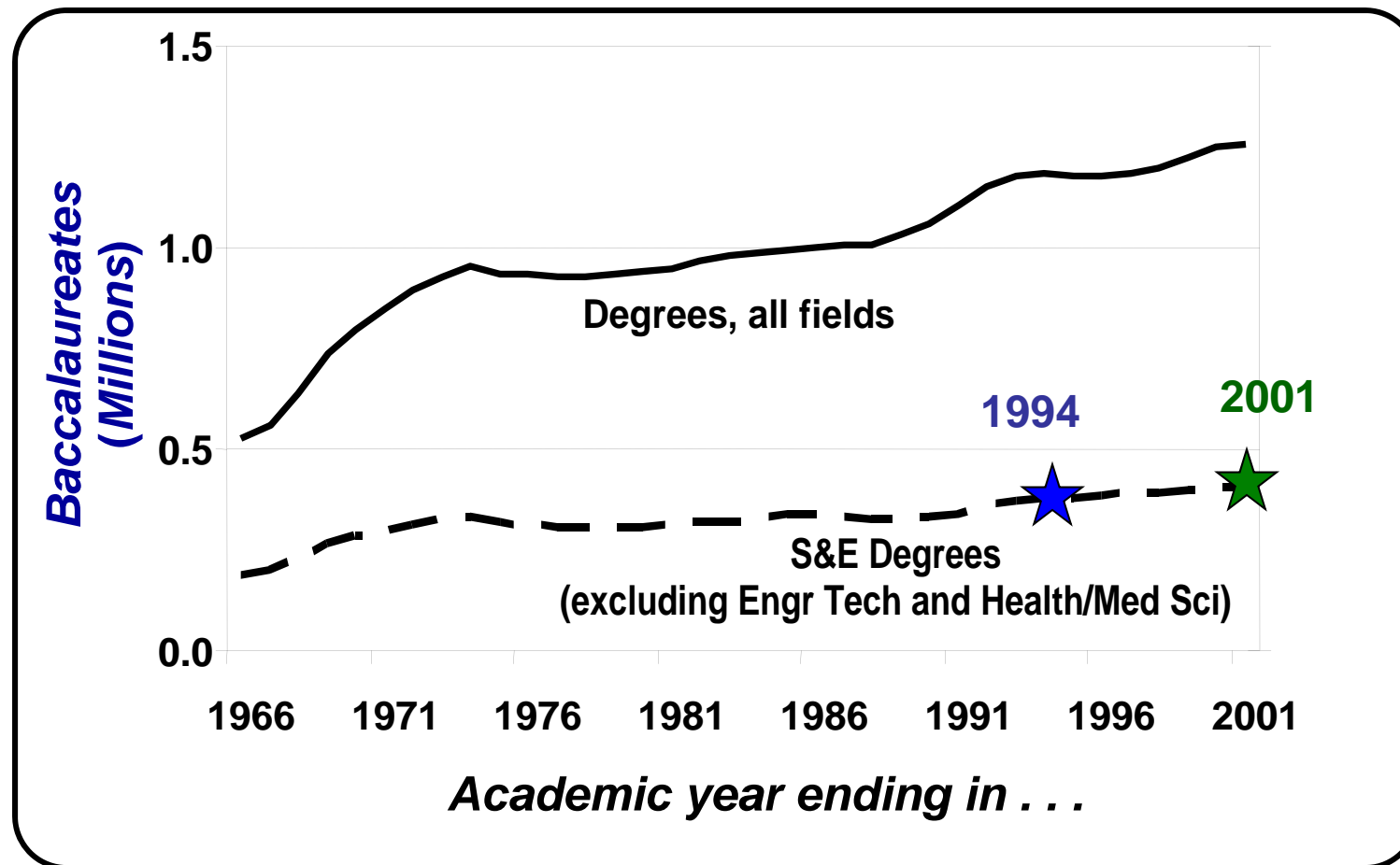
Source: *Money Magazine*, Oct 2004, pg 124

FOUO

U.S. Production of S&E Graduates*



U.S. College and University Graduates, 1966-2001



*Source: Data provided by the NSF, September 2003

U.S. University Trends in Defense-Related S&E Graduate Student Enrollment (1994-2001)



*Source: National Science Foundation – Graduate Students and Post Doctorates in Science and Engineering: Fall 2001

Science Disciplines

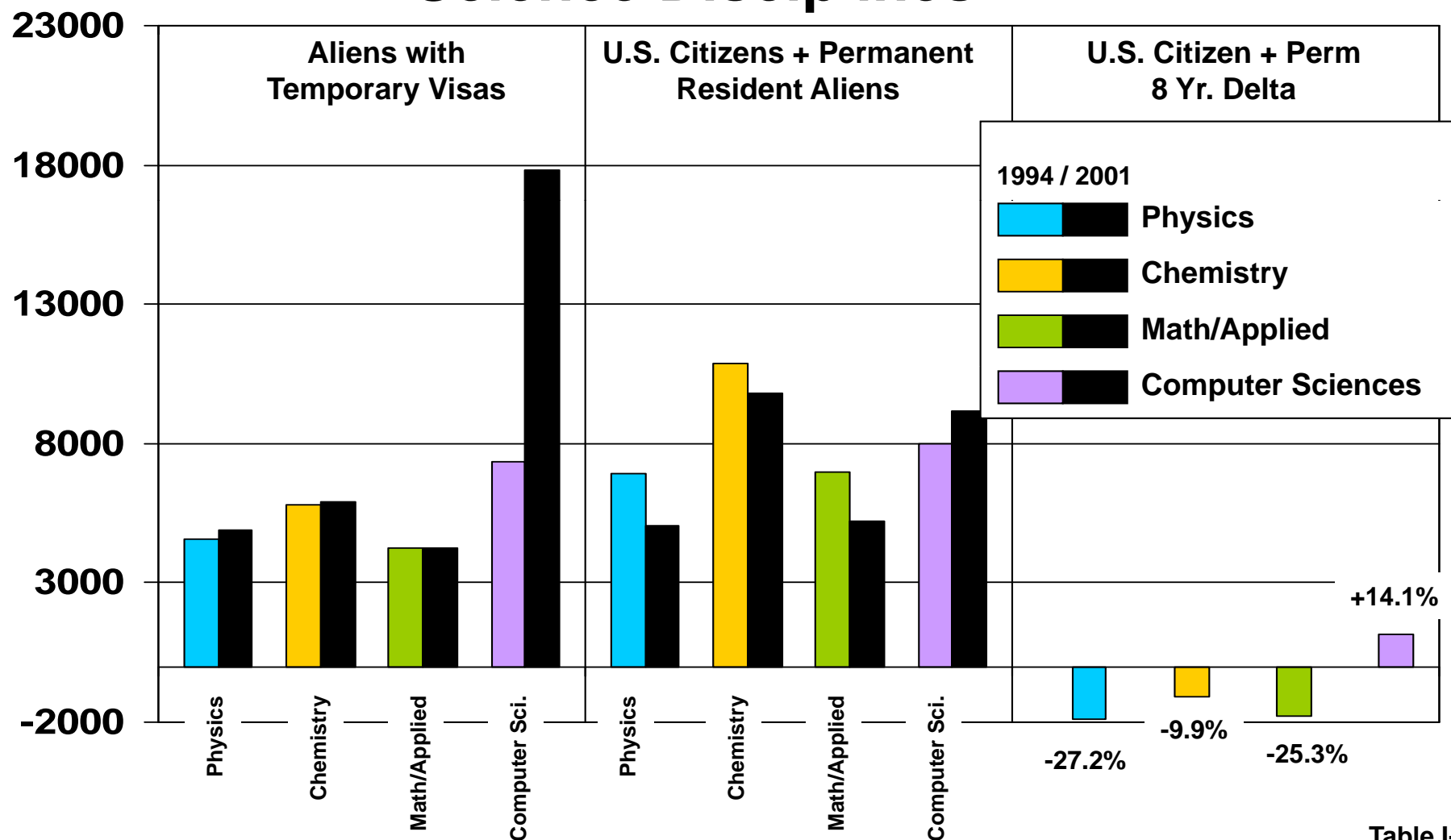
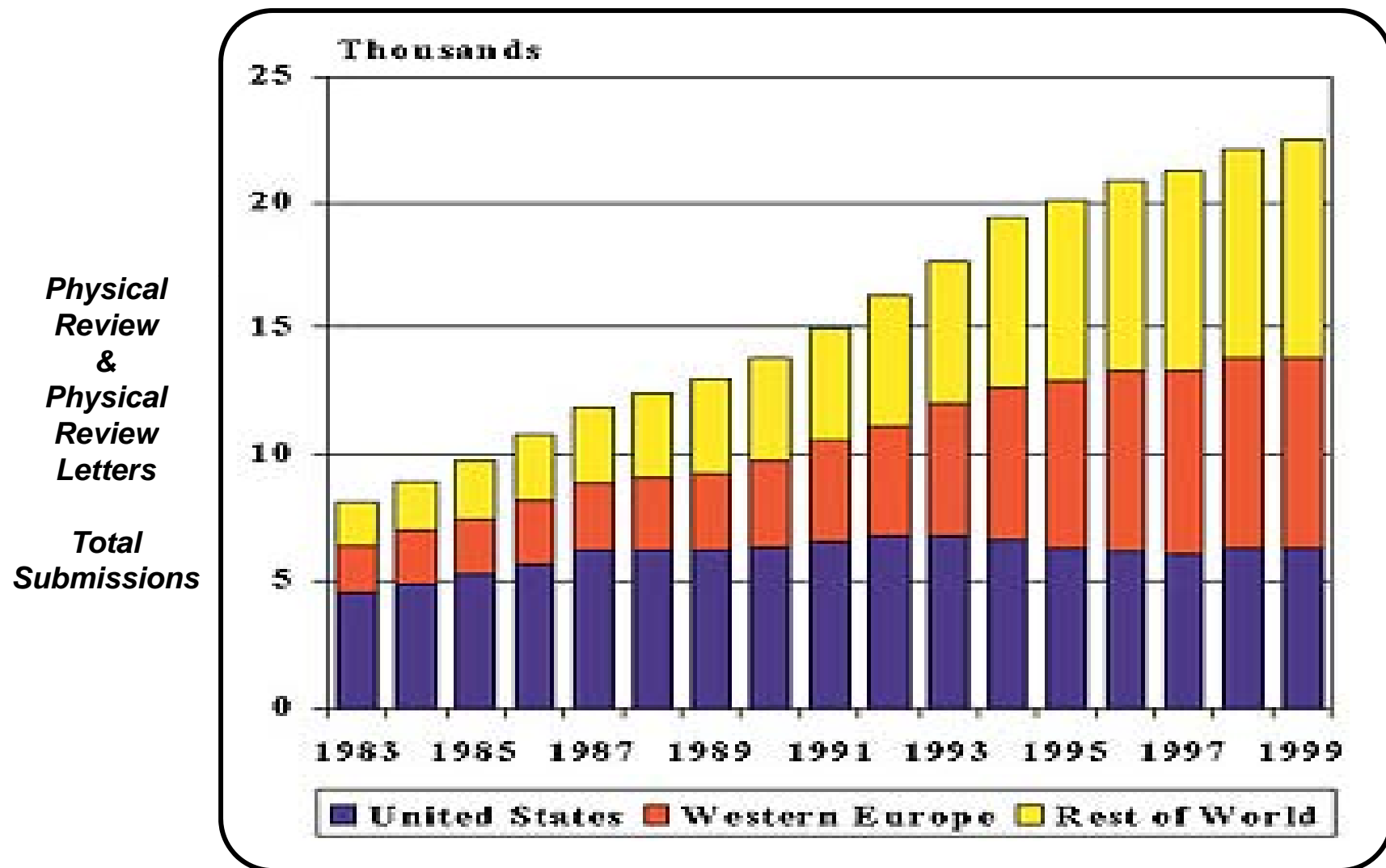


Table I-2

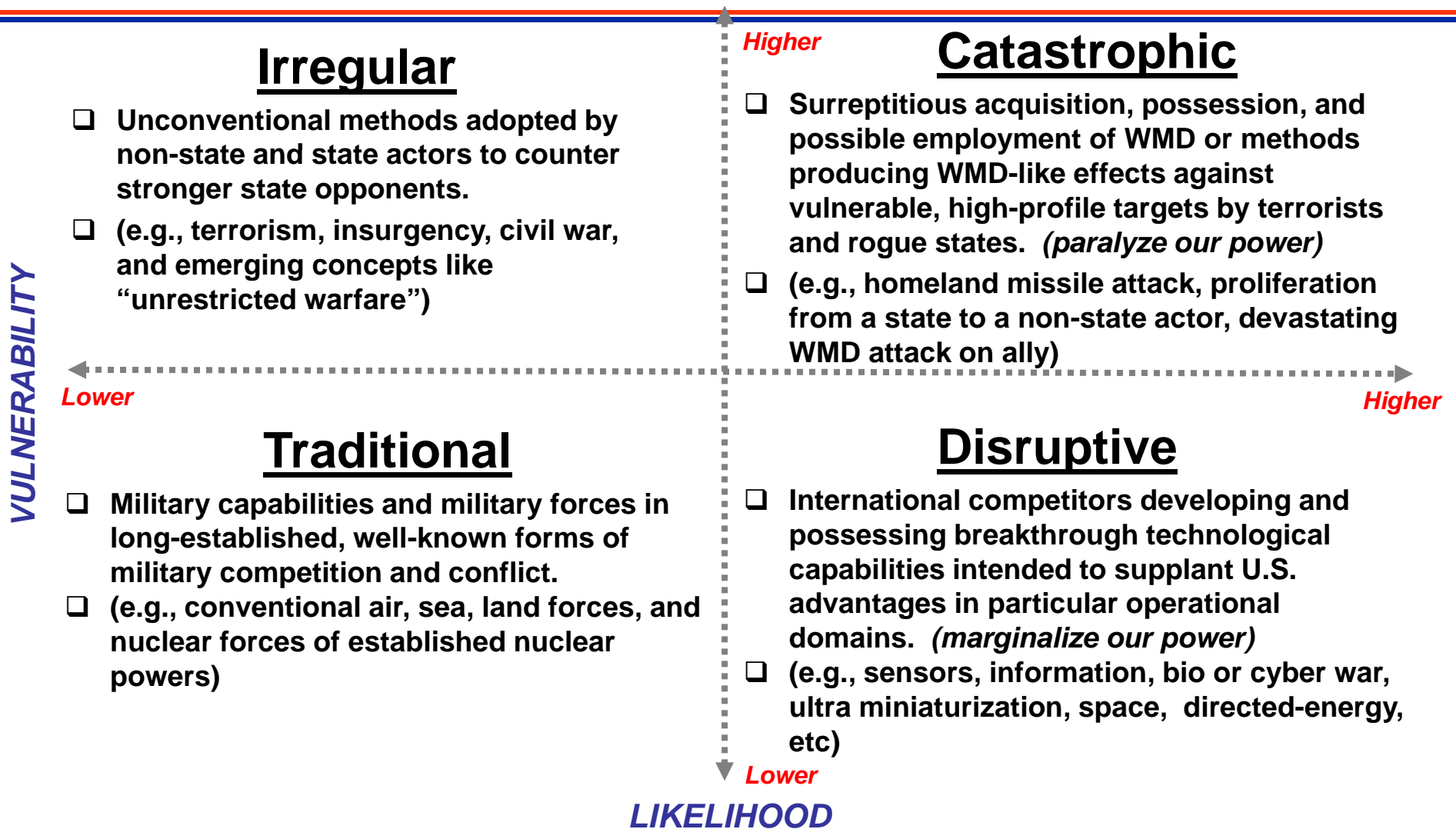


Physical Review Trends



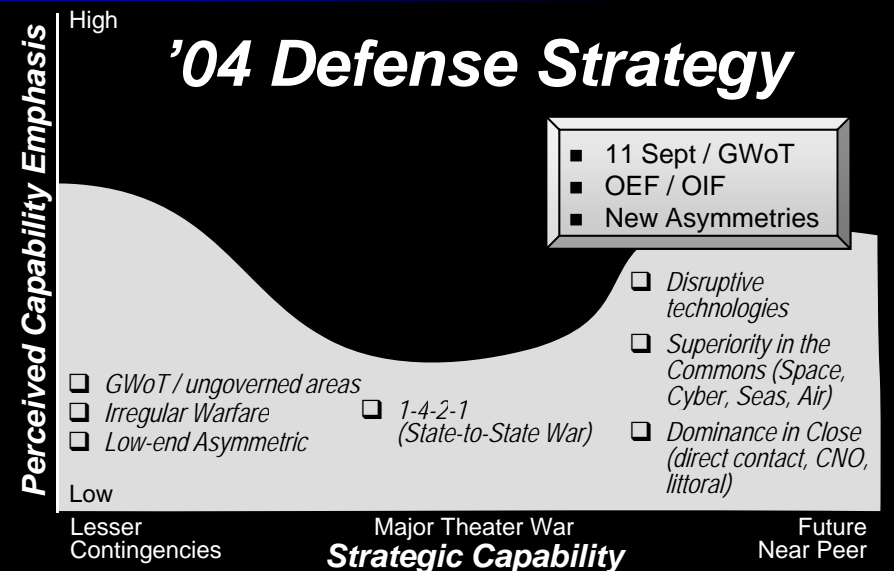
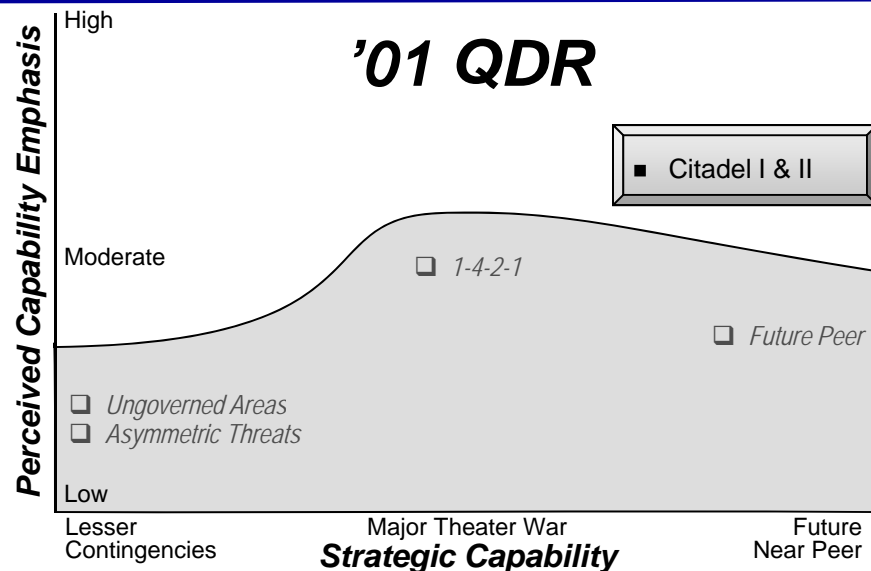
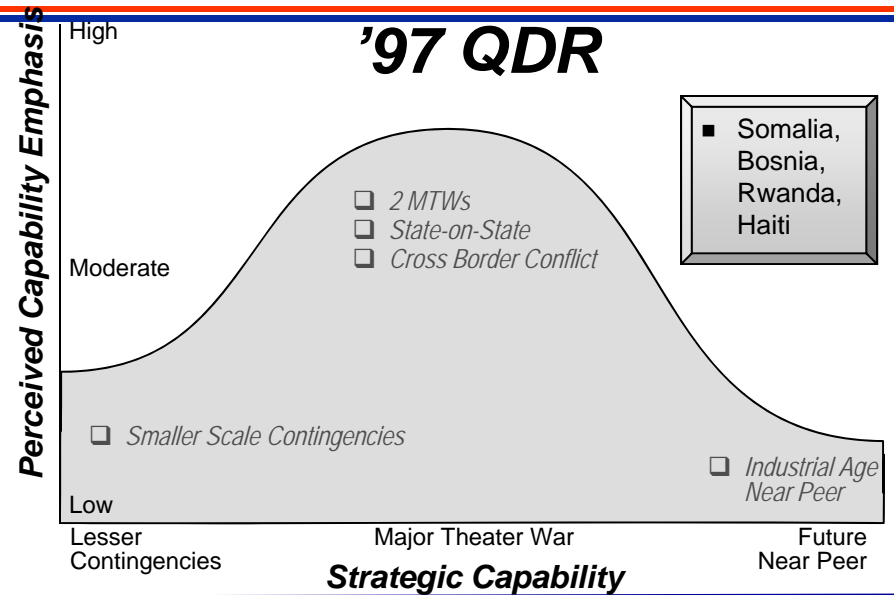
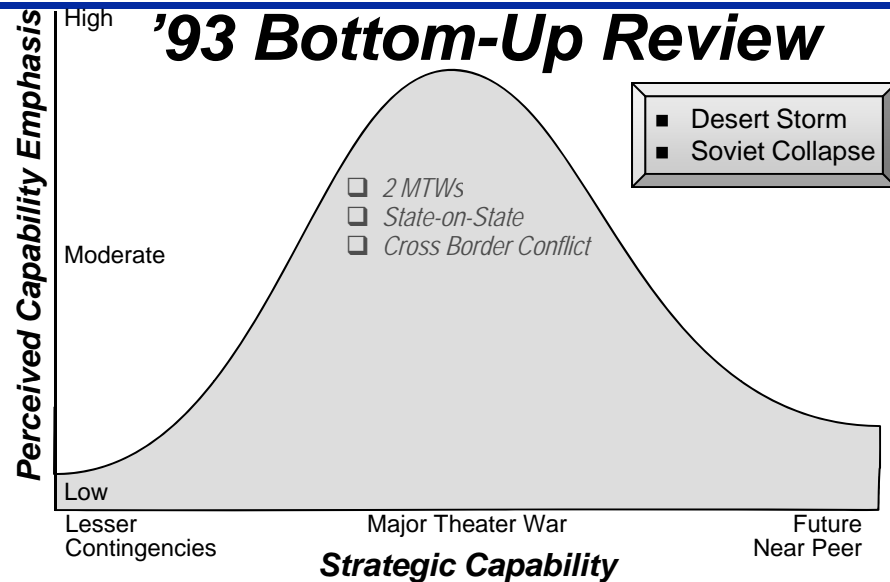
Source: American Physical Society - APS News August/September 2000

Security Environment: 4 Challenges



Capabilities-based planning should balance risk across challenges

Decade of Strategic Evolution



Disruptive Technology Dimensions

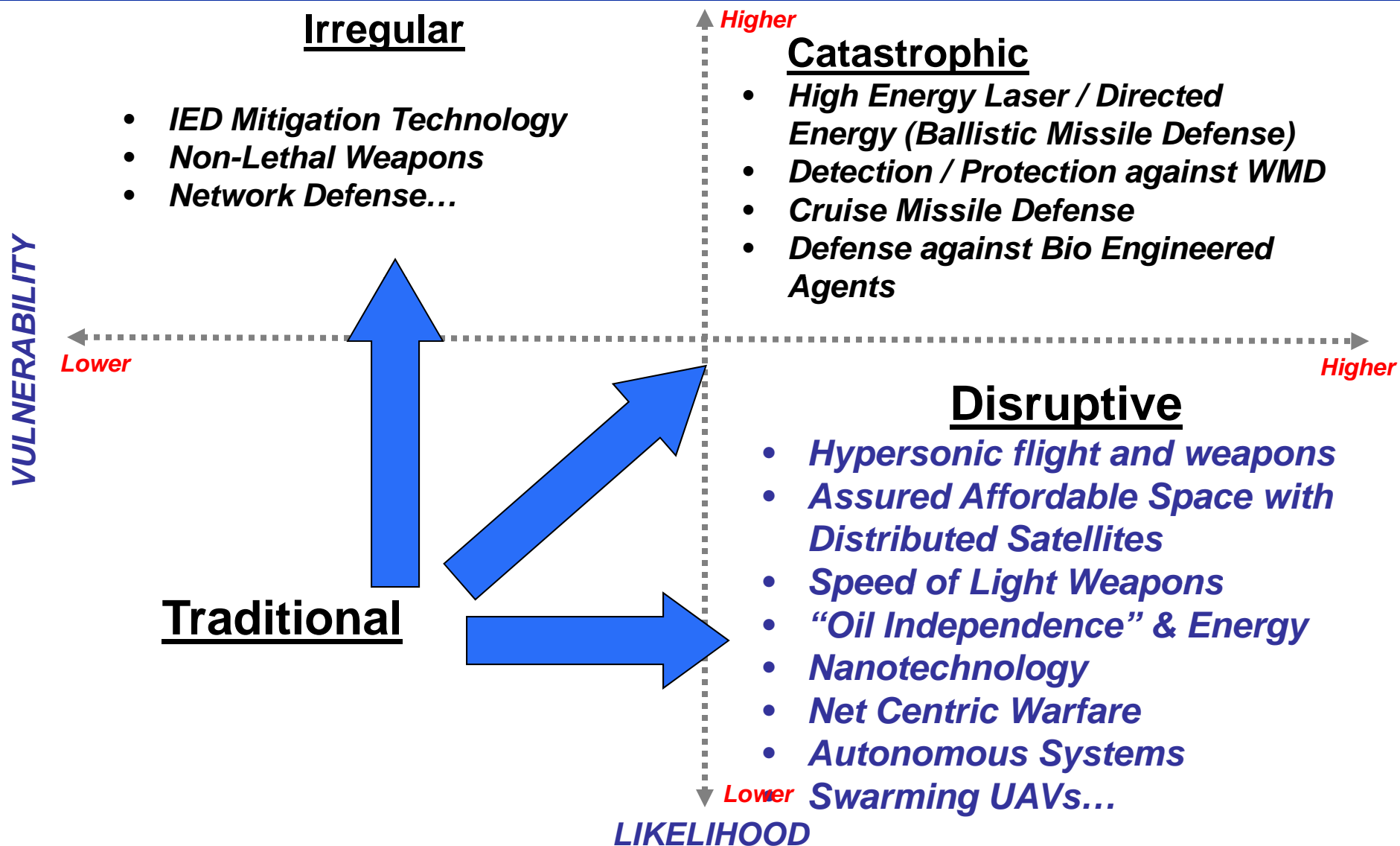
Attributes



- Transformation Occurs With Leaps In Capabilities:
 - Manhattan Project—Lethality
 - Reconnaissance Satellites—Knowledge
 - Stealth—Agility
 - Ballistic Missiles—Speed

***Offensive Disruptive Technology is
Transformational***

Security Environment: Strategy S&T “Thrusts”

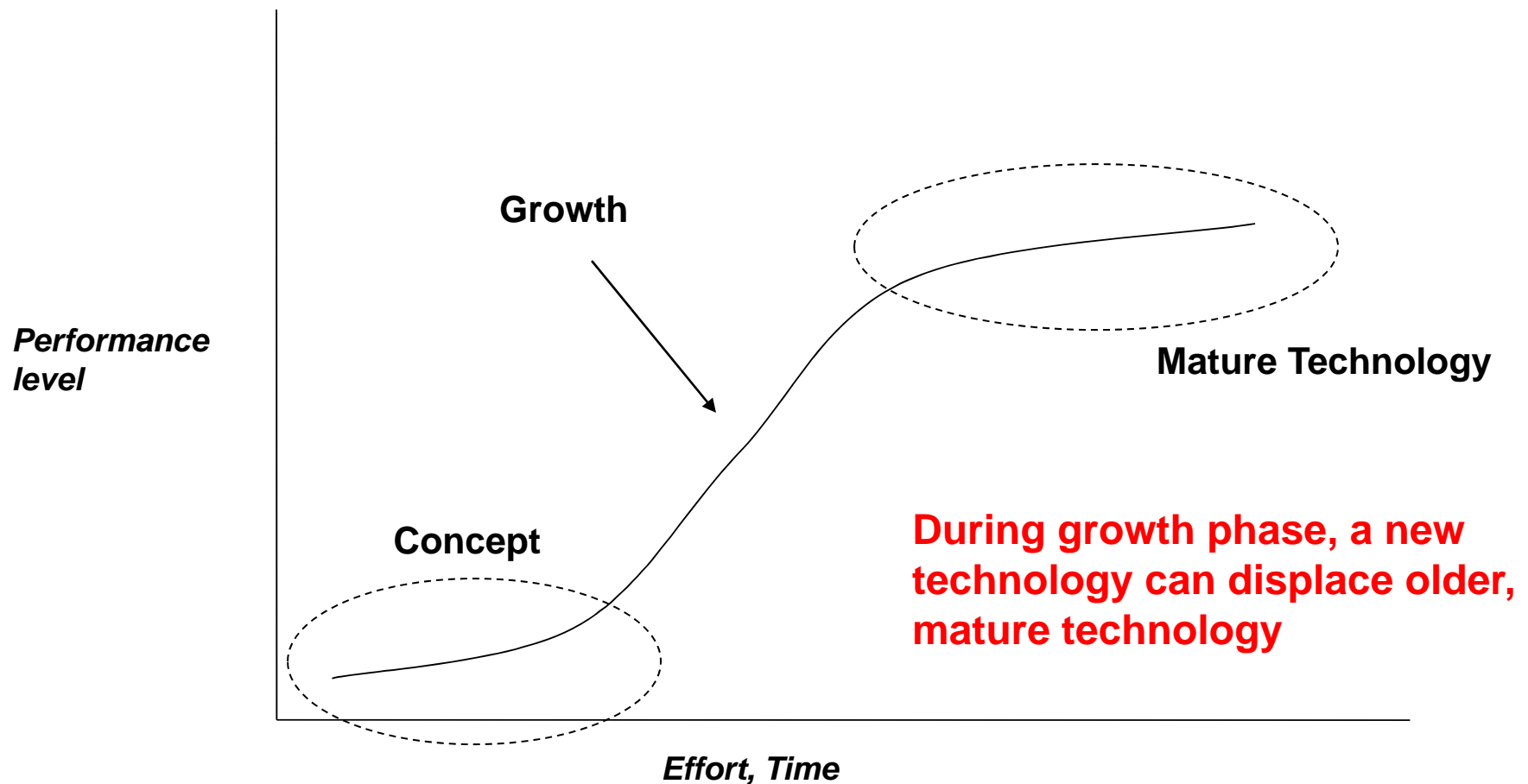




A Final Concept *Technology S-Curve*

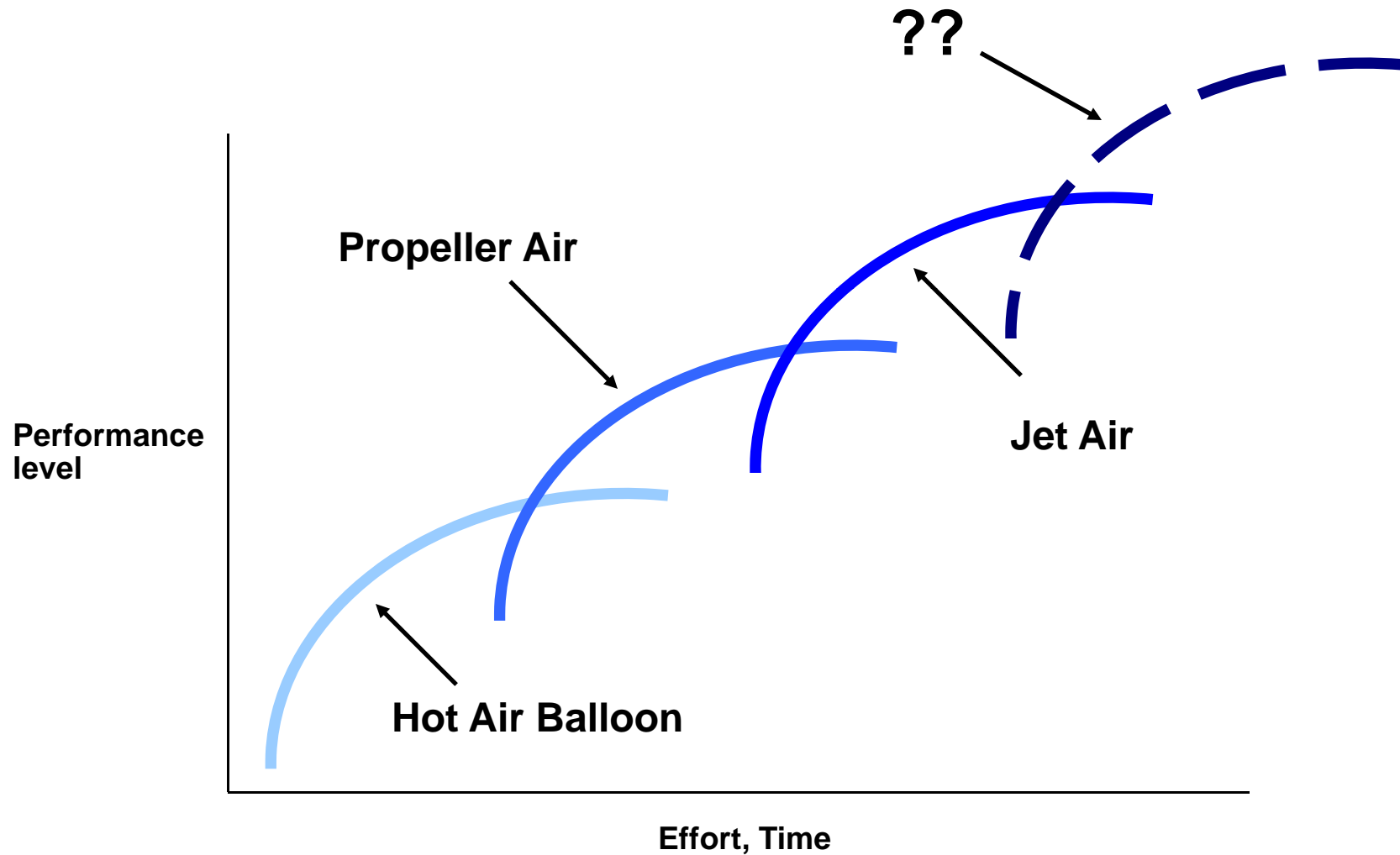
Most Technology maturation follows S-curve:

Initial Discovery, “Product-ization”, then Incremental Improvement



Family of S-Curves

Military Aircraft

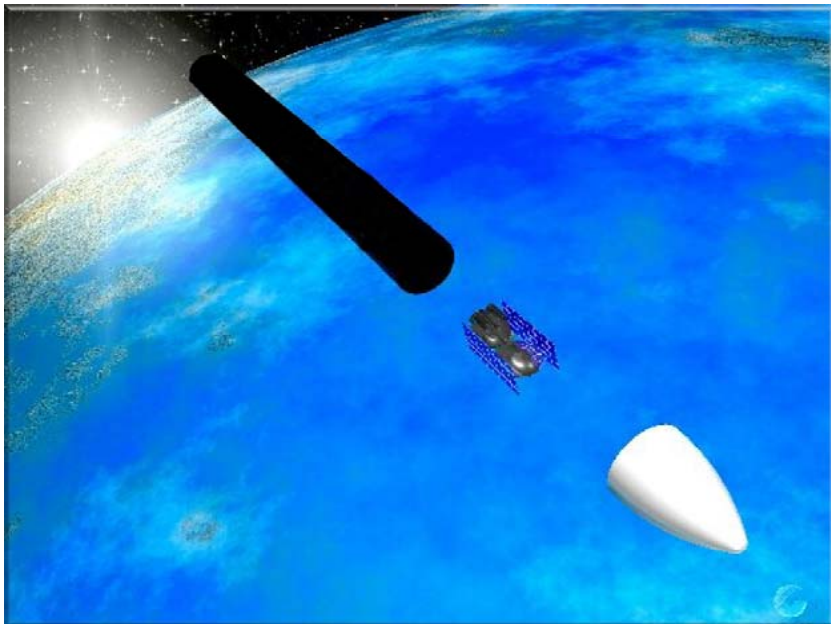


Falcon



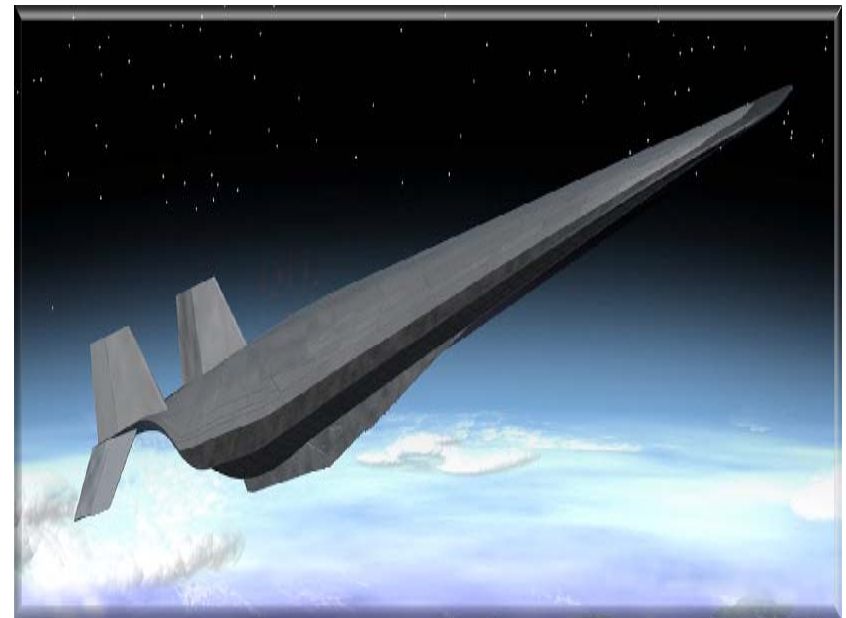
Near-Term Capability

Operationally
Responsive
Spacelift
Capability



Far-Term Capability

Hypersonic Cruise
Vehicle



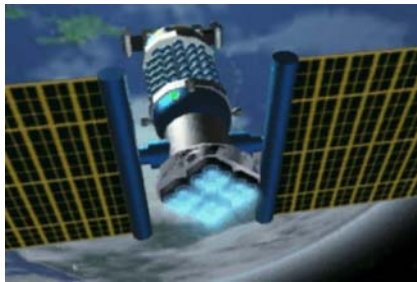
DARPA – Air Force Program



Propulsion Technology

Turbine Propulsion and Fuels Technology

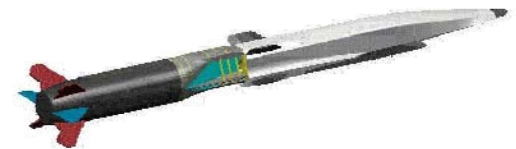
- Engine Component Development • Demonstrator Engines • Fuels, Lubes, and Combustion



Rocket Propulsion Technology

- Rocket Engine and Fuel Technologies
- Satellite Propulsion • Tactical and Ballistic Missile Propulsion

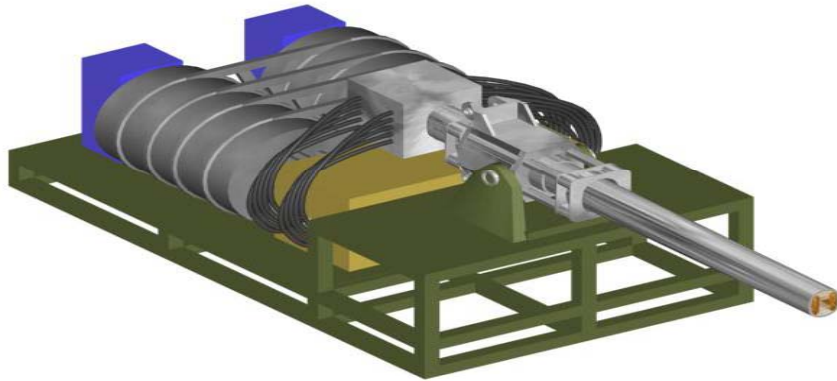
- Advanced Propulsion Technology -** • Hypersonic Flight (Mach 4-8) Components • Scramjet Demonstrator Engines
- Endothermic Fuels



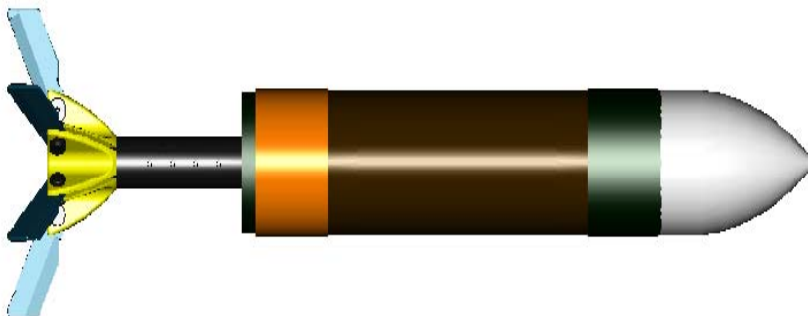
Aircraft and Weapon Power -

- Electrical Power Generation and Thermal Management for Aircraft • High Power Generation and Storage for Space and Directed Energy

Electromagnetic Mortar (EM Mortar)

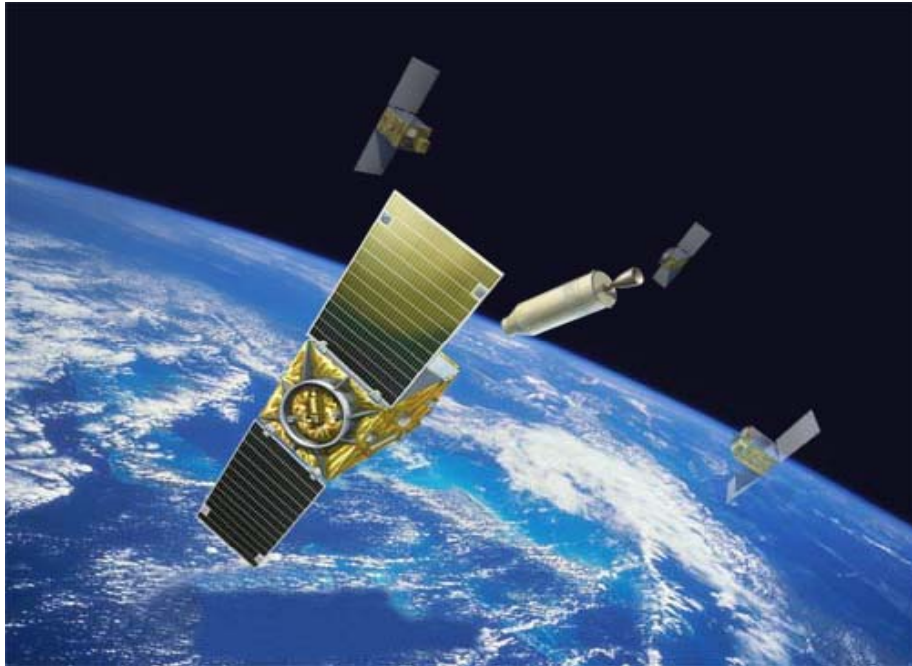


- Precision, lethality, fast response, rapid strike, and versatility for artillery and sensor launch





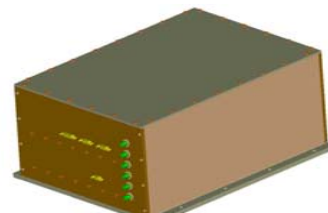
AF XSS-11



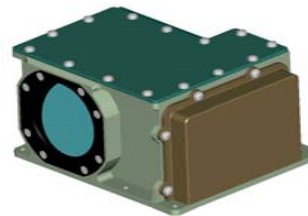
- **First demonstration of a fully autonomous satellite designed to demonstrate:**
 - Software logic and algorithms to safely rendezvous and navigate around and inspect a resident space object
 - Mission planning, validation, verification tools, and operational tools and techniques
 - Collision avoidance—space situational awareness



**3u PCI
Avionics**



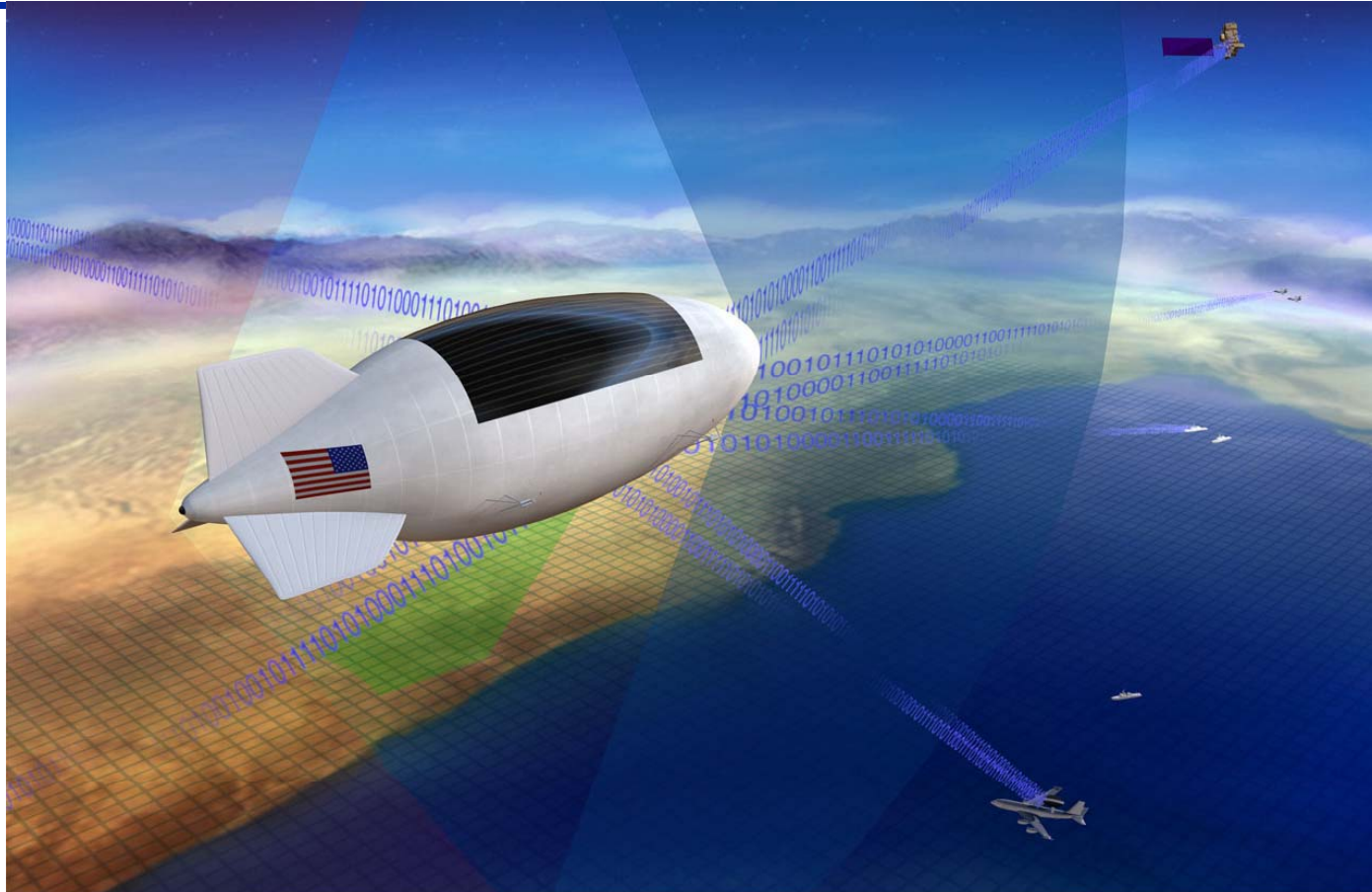
**Light detection and ranging
rendezvous system**



**Integrated imager and
star camera**



High Altitude Airship (HAA)



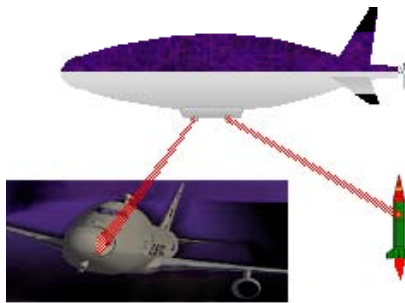
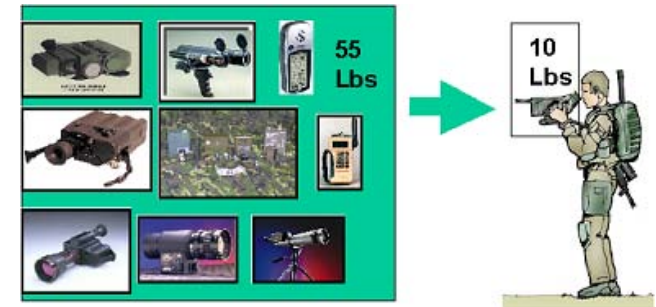
Transformational military capability; potential use as sensor, communications, and/or weapons platforms; demonstrator for future high altitude airships.



Directed Energy

Laser Devices and Analyses:

- Laser Devices - Photon Generators • Solid State and Chemical Lasers • Laser System Effects and Modeling



Laser Beam Control and Optics:

- Atmospheric Compensation/Beam Control Techniques to Get the Beam on Target to Do the Mission • Space Situational Awareness • Laser Communications

High Power Microwaves (HPM):

- Devices for Graduated Effects - Disrupt, Degrade, Damage, Destroy Electronics • Non-Lethal Long-Range Technologies



Effects at the Speed of Light

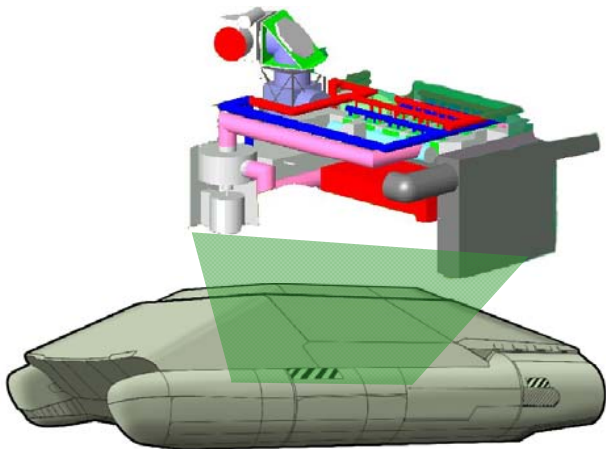
Lethality – Directed Energy

Lethality



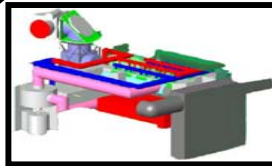
Solid State Laser Weapon

- **SSL Weapon System Demonstrator for FCS**



High Power Microwave (HPM) Enabling Technology

- High Power Electronics
- Antenna Technology



Solid State Laser (SSL)

- 25 kW/100 kW SSL Lab Demo
- SSL Weapon System Components
- 400 kW SSL Lab Demo (FY12)

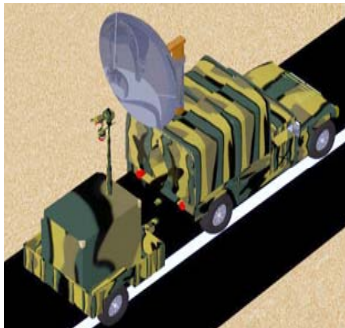
HEL/Space Concepts

- Novel DEW Designs
- Space Control Concepts

Advanced Laser Technology

- Novel Materials
- Beam Combining
- New Laser Configurations

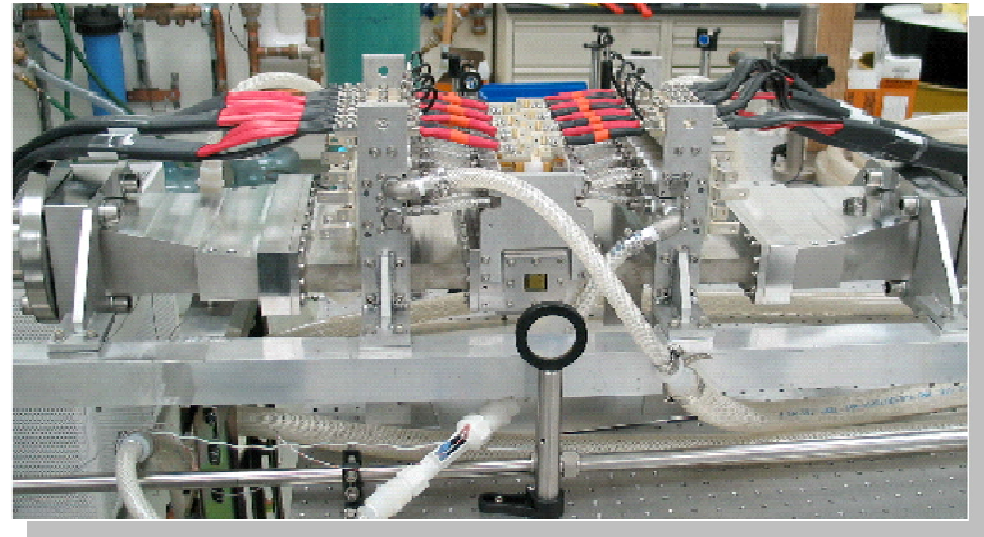
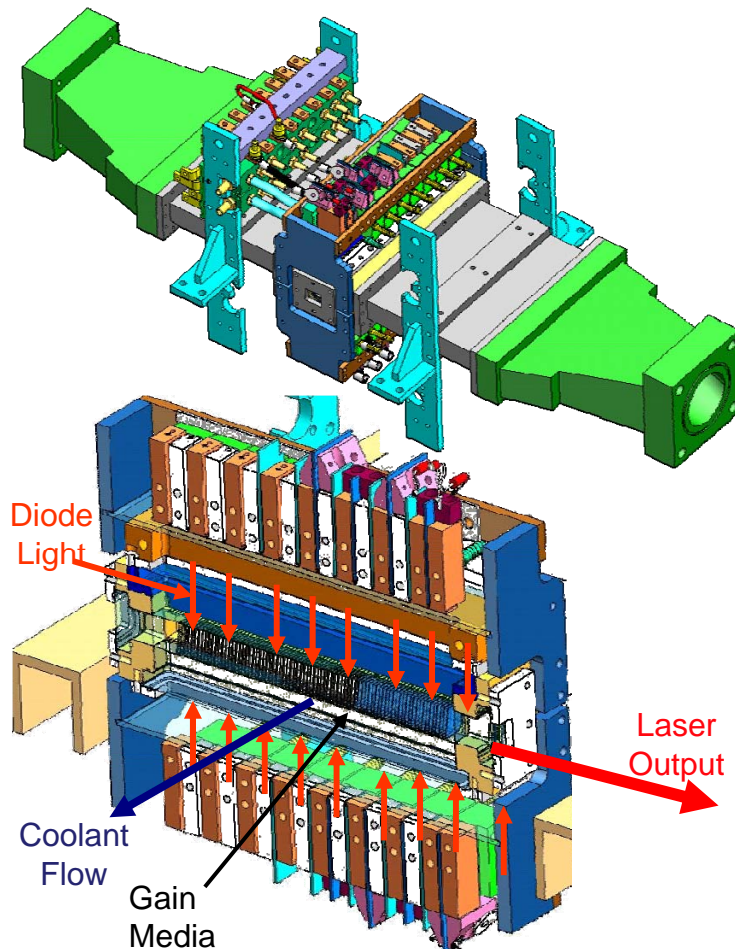
Ground-based Mobile Electronic Attack



Rheostatic Pulsed Energy Weapon System



Liquid Laser

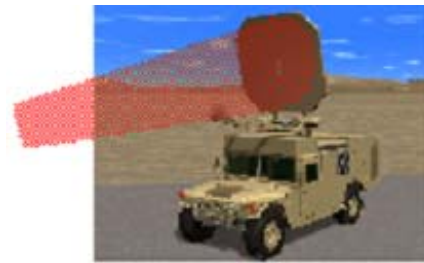


- ***Novel Design That Combines the Energy Density of a Solid State Laser with the Improved Thermal Management Qualities of a Liquid Laser***
- ***System Goals: 150 kW Laser Output, 5 kg/kW***
- ***Enables Laser Weapon Systems Integration with Tactical Platforms***



Airborne Active Denial

- Key technologies for airborne non-lethal anti-personnel directed energy weapon
- Non-lethal capability from operational altitudes
 - Deep magazine
 - Speed-of-light
 - Line-of-sight
- Energy beam heats adversary's skin
 - Causes intense pain
 - No damage
 - Forces adversary to flee



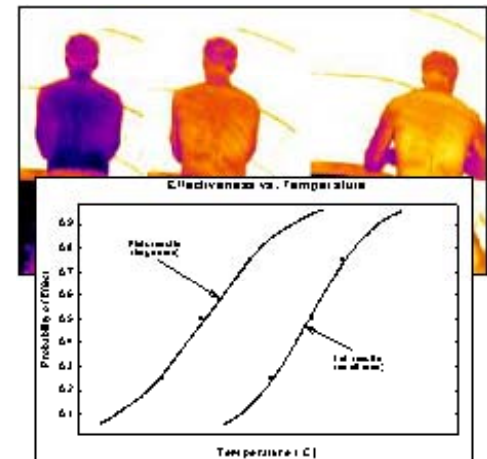
Ground
Based
ACTD



Advanced Gyrotrons



Electrical Power



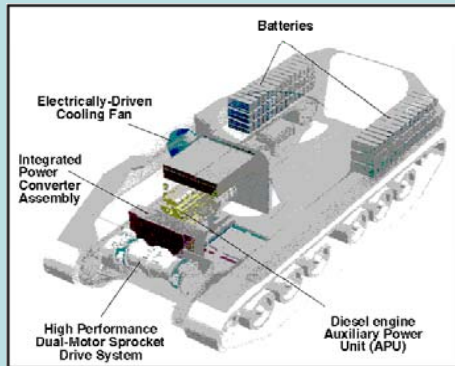
Human Effects Validation

Power and Energy Technologies

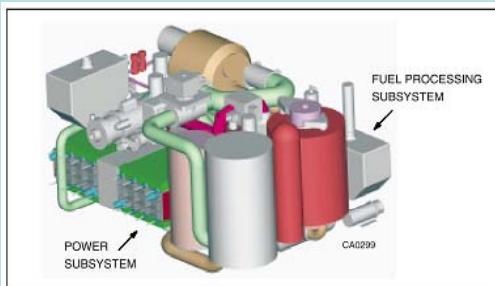
FY06-11



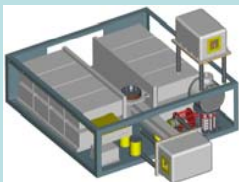
FCS Vehicle Power



Hybrid Electric Drive



Diesel Reformer Power



Pulse Power for...
Electric Weapons & Protection
6x Power Density

- All Electric vehicles
- Fuel efficiency
- Silent mobility

- Minimize deployment time
- Self Sustainment
 - 3 days - High optempo
 - 7 days - Low optempo
- New capabilities
 - Lethality
 - Survivability

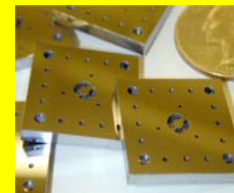
Soldier System Power

- Reduce weight
- Increased power
- Increased mission time

Fuel Cell (1.5 lbs)

Rechargeable Battery Belt (1 lbs)

Methanol Canister (1.5 lbs)



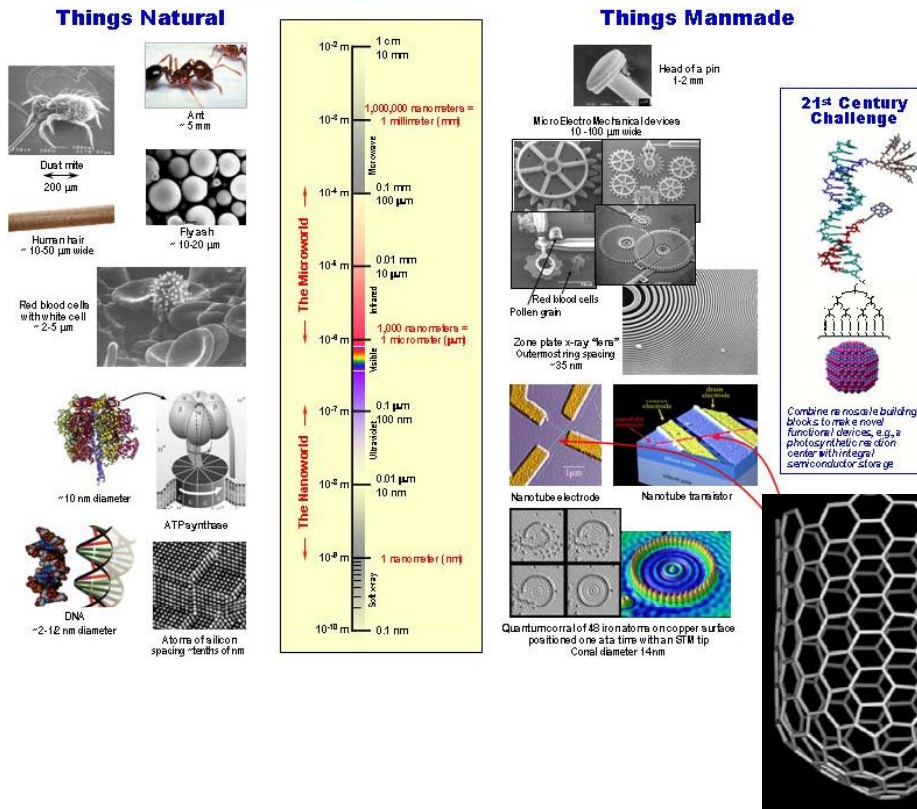
**Microturbine/
Microengines**

10x Power Density



Single-Wall Carbon Nanotubes

The Scale of Things -- Nanometers and More



Objective:

SWNT's are the strongest and the best thermal materials known to man.

Robust program will demonstrate technologies for scalable production, processing and manufacturing of SWNT's

Payoff:

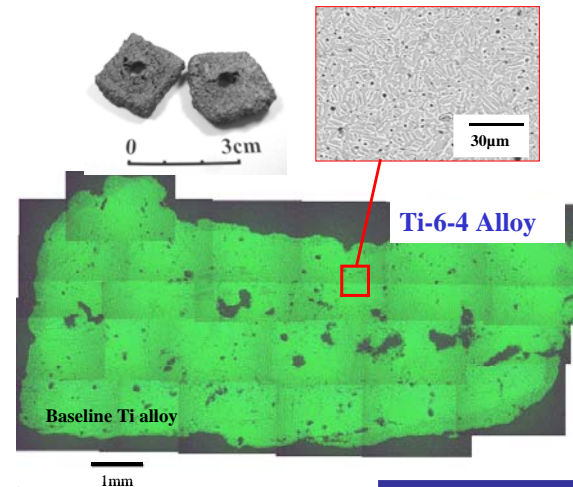
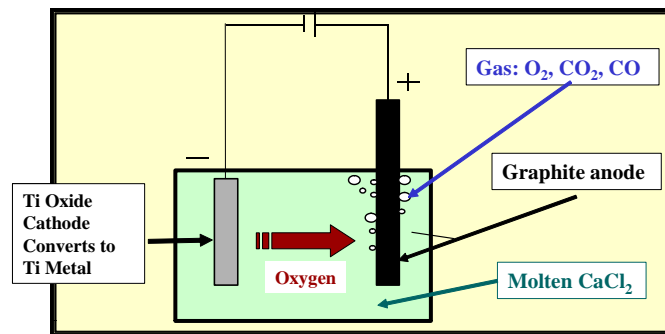
- Light, Strong power/signal harnesses
- Light, high power density motors
- Thermal management/heat pipes
- Regenerable CO₂ scrubbers
- Fuel cells
- Photovoltaics/themophotovoltaics

Single-Wall Carbon Nanotube (SWNT)

Property	SWNT	Copper	Aluminum
Conductivity	10 ⁴ -10 ⁷ mho	5x10 ⁵ mho	3.8x10 ⁵ mho
Weight	1.4 g/cc	8.9 g/cc	2.7 g/cc
Stability	inert to 500C	corrodes	surface oxide
Thermal Expansion	-2 ppmC ⁻¹	-16 ppmC ⁻¹	23 ppmC ⁻¹
Thermal Conductivity	20-2000 Wm ⁻¹ K ⁻¹	400 Wm ⁻¹ K ⁻¹	116-235 Wm ⁻¹ K ⁻¹
Tensile Strength	5-20 GPa	0.4-1.5 GPa	0.1-0.6 GPa



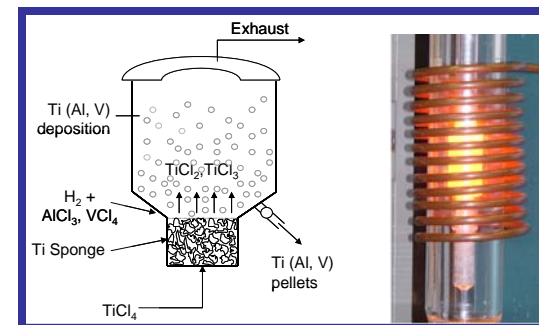
Low Cost Titanium



- Several competitive routes being examined:
 - Electrolytic
 - Fluidized Bed
 - Na Reduction
- Target: < \$4/lb



Cost estimates as low as \$1.00-\$2.50/lb



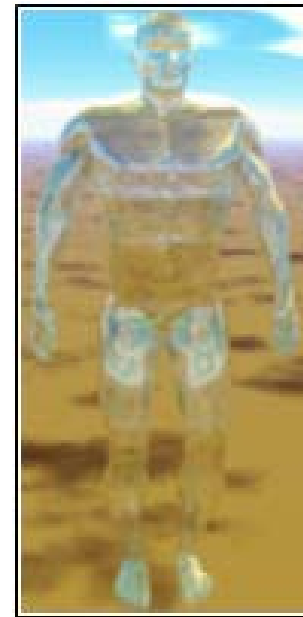


“SHAPE SHIFT” OVERVIEW

- Undetected Insertion Anywhere on Globe: **Provide Technologies That Enable SOF Platforms, Equipment and Operators to be “Invisible” in All Media (Air, Land, Sea), From All Senses, From All Sensors, in Any Environment**



Outline and Thermal Masking



Full Spectrum Masking

DoD Needs One More “Transformation”



The Information Transformation

Every DoD Researcher, Acquisition Professional, Tester, and Operator should be able to sit down at their Desktop computer and be able to find out:

- What the DoD is doing in R&E
- Why we are doing the work
- When the work will be done
- Who knows more about this information

“Smarter Google” for the RDT&E and Warfighter Community



The Vision

- Who is conducting work in technology X?
- How much?
- What are their deliverables?
- What are the technology transition targets?



R&E Portal



R&E Portal Home Page - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Back Forward Stop Home Search Favorites Media

Address https://rdte.sra.com/portal/page?_pageid=34,36601,34_36637&_dad=portal&_schema=PORTAL Go Links

R&E PORTAL

DoD Research & Engineering

Portal Home R&E News DDR&E Initiatives E-Gov Initiative Financial Management Strategic Plans Congressional Reporting R&E Communities DDRE

DDR&E Initiatives

+ National Aerospace Initiative

OBJECTIVES

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- DefenseLINK
- alltheweb (all .mil)
- Google (all .mil)

DefenseLink Top News

Refresh

SICK CALL - Crowds of Indonesians gather outside one of the buildings of the Kalabahi Hospital, in Alor, Indonesia, waiting their turn to be seen by civilian and military medical professionals from the hospital ship USNS Mercy on March 26, 2005. U.S. Navy photo by Petty Officer 3rd Class Rebecca J. Moat. [Hi Res Photo](#) | [More Photos](#)

Report Suggests Family-Friendly Initiatives
WASHINGTON, March 31, 2005 - A Defense Department-sponsored military women's advisory panel recommends that the armed forces discontinue the practice of simultaneously deploying both military parents of minor children. [Story](#)

First Lady Thanks Troops at Bagram Air Base
WASHINGTON, March 31, 2005 - "We support you, we believe in you, and we're proud of you." That was the message first lady Laura Bush carried to U.S. troops at Bagram Air Base during her March 30 visit to Afghanistan. [Story](#) | [Power of Freedom Evident in Afghanistan](#) | [Photos](#)

Rice: Elections Show Trend Toward Democracy
WASHINGTON, March 31, 2005 - Elections in Afghanistan and Iraq are examples of a growing trend toward democracy worldwide and "examples of the universal aspiration of all people to make their voices heard and to govern themselves," Secretary of State Condoleezza Rice said earlier this week. [Story](#)

Information Access Key in Fighting Terror War
WASHINGTON, March 31, 2005 - The war on terror is proving to be an information war, with forces demanding and getting more access to information than in any previous conflict, U.S. Central Command's director of command, control, communications and computer systems told the American Forces Press Service. [Story](#)

Defense Technology Search

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- [Research & Development Descriptive Summaries](#)
- [Science.gov](#)
- [S&T Acquisition Workforce](#)

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R&E POC Search

Search:

FACING THE FUTURE

SPOTLIGHT ON TRANSFORMATION - A booklet titled "Facing the Future: Meeting the Threats and Challenges of the 21st Century," a series of American Forces Press Service articles and a Pentagon Channel TV documentary chronicle the Defense Department's transformation since 2001. [Special Report: Facing the Future Booklet \(pdf\)](#) | [More](#)

Start

1:35 PM



Summary

- **Understanding Disruptive Technologies are vital to continued competitive stature**
- **With Increased Knowledge in Rest of World, Pace of Technology, Potential for Technology Surprise Increasing**
- **Need to stay engaged with rest of world to minimize “surprise”**



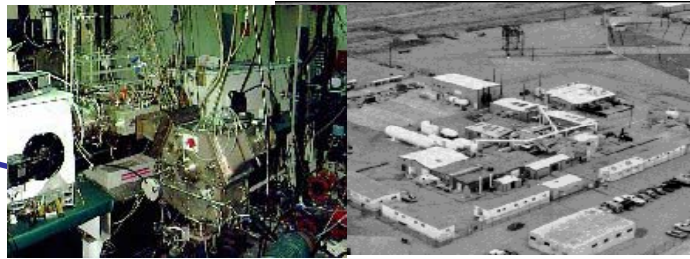
Backup Slides



S&T Can Take Time for Transition



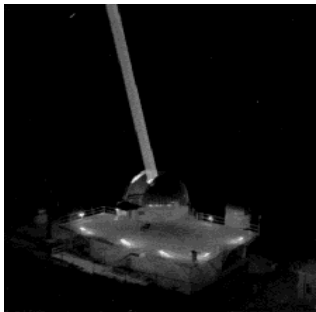
Adaptive Optics



Chemical Oxygen Iodine Laser



Airborne Laser Laboratory



1.5m Telescope

30+ Years of Air Force S&T investments in beam control and high energy lasers have made an ABL Possible



Atmospheric Compensation



3.5m Telescope



Atmospheric Measurements



Argus Airplane



Harp Airplane



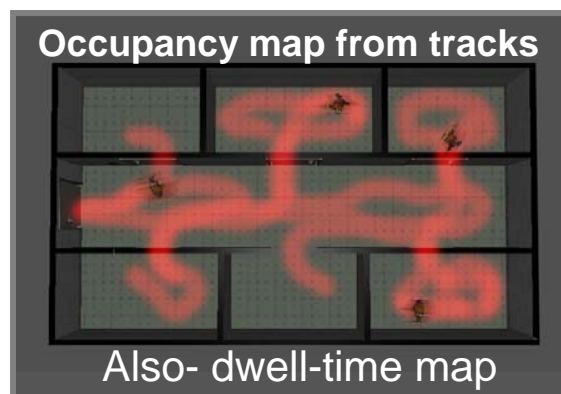
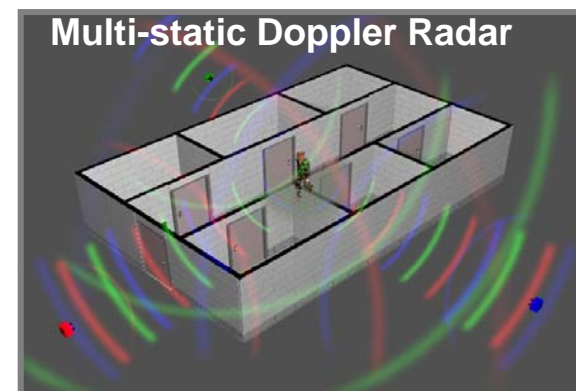
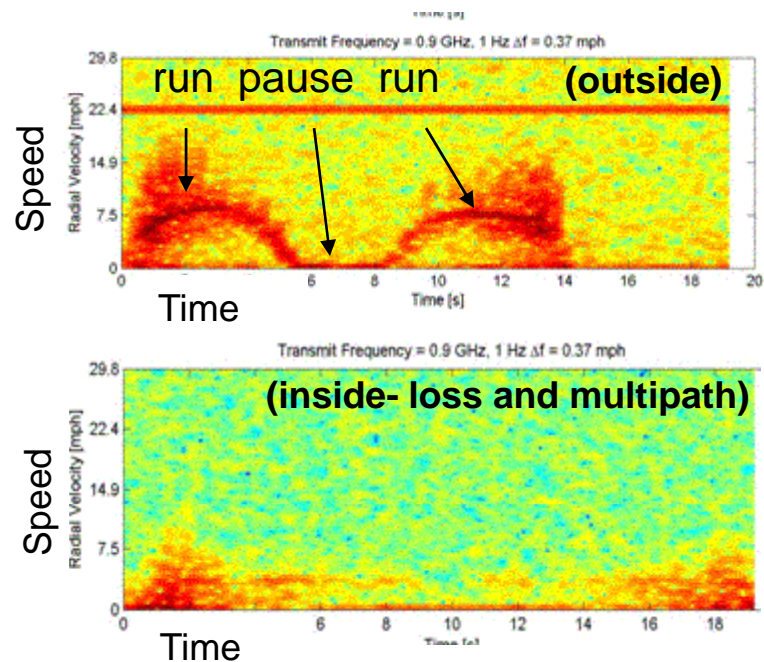
Through-the-Wall Imaging for Urban Operations



MTI Radar

- Strategic collection of threat activity patterns and building layout / door properties using exterior sensors
- Tactical detection and localization of adversaries or hostages inside building using exterior sensors

900 MHz Doppler Returns from walker:

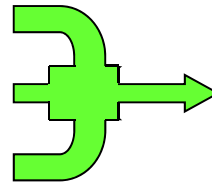


Counter-IED Thrust



- Recently launched (Feb 05) a focused counter-IED research program w/ NRL, University Affiliated Research Centers, etc
- Sustained BASIC Research investment: 10% NRL Base Program; matching ONR extramural funds (to universities, labs, industry, etc.)
- Investment on real-time detection of threat & advanced long-range destruction technologies
- “Feed” USMC CONOPS/Training
- Deliver Counter-IED S&T Roadmap to SECNAV

- Detection at a Distance
- Destruction at a Distance
- Defeat at a Distance



Deterrence

Army S&T Vision— Pursuing Transformational Capabilities

Speed, Reach, and Precision



Current Force



~100 lb. load



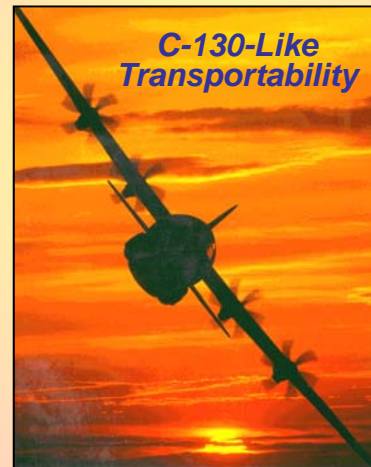
70+ tons



< 10 mph

*From Platforms to
System of Systems*

Enabling the Future Force



*C-130-Like
Transportability*

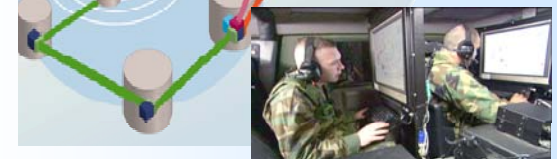
Enhancing the Current Force

Future Force

*< 40 lb.
load*



Fully networked



< 20 tons



> 40 mph

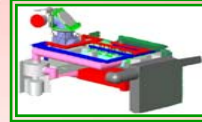
Disruptive Technologies



Through Wall Sensing



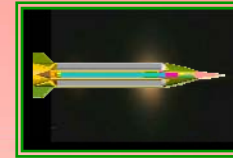
Network Mining



100kW Lab Laser Demo



Non-Line of Sight launch system



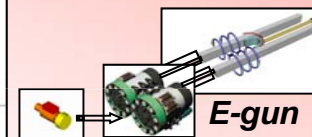
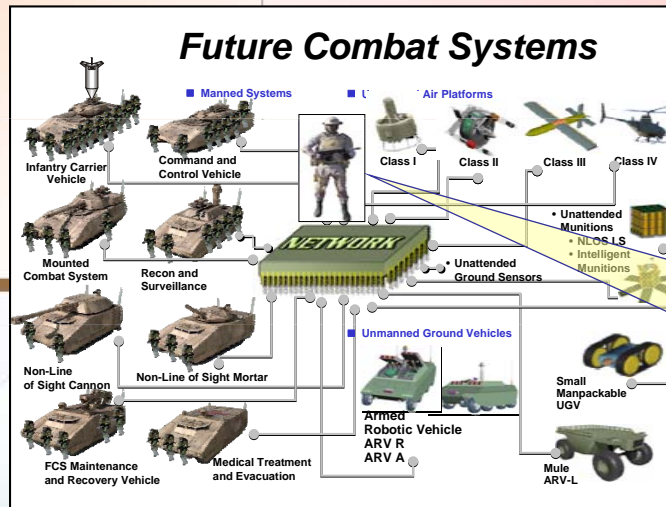
Compact Kinetic Energy Missile (CKEM)



Flexible Displays



Net Centricity



E-gun



HPM

Lethality



Active Protection



Survivability



Full Spectrum Command



Training



Flatworld



Virtual Dilemma



FFW



Autonomy



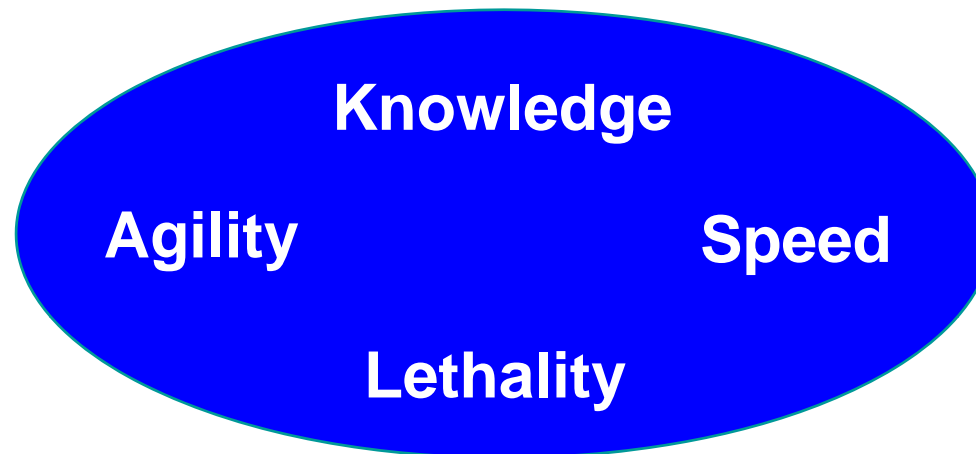
Swarming

Robotics

Providing Strategically Responsive Forces with Information Dominance and Paradigm Shifting Lethality & Survivability

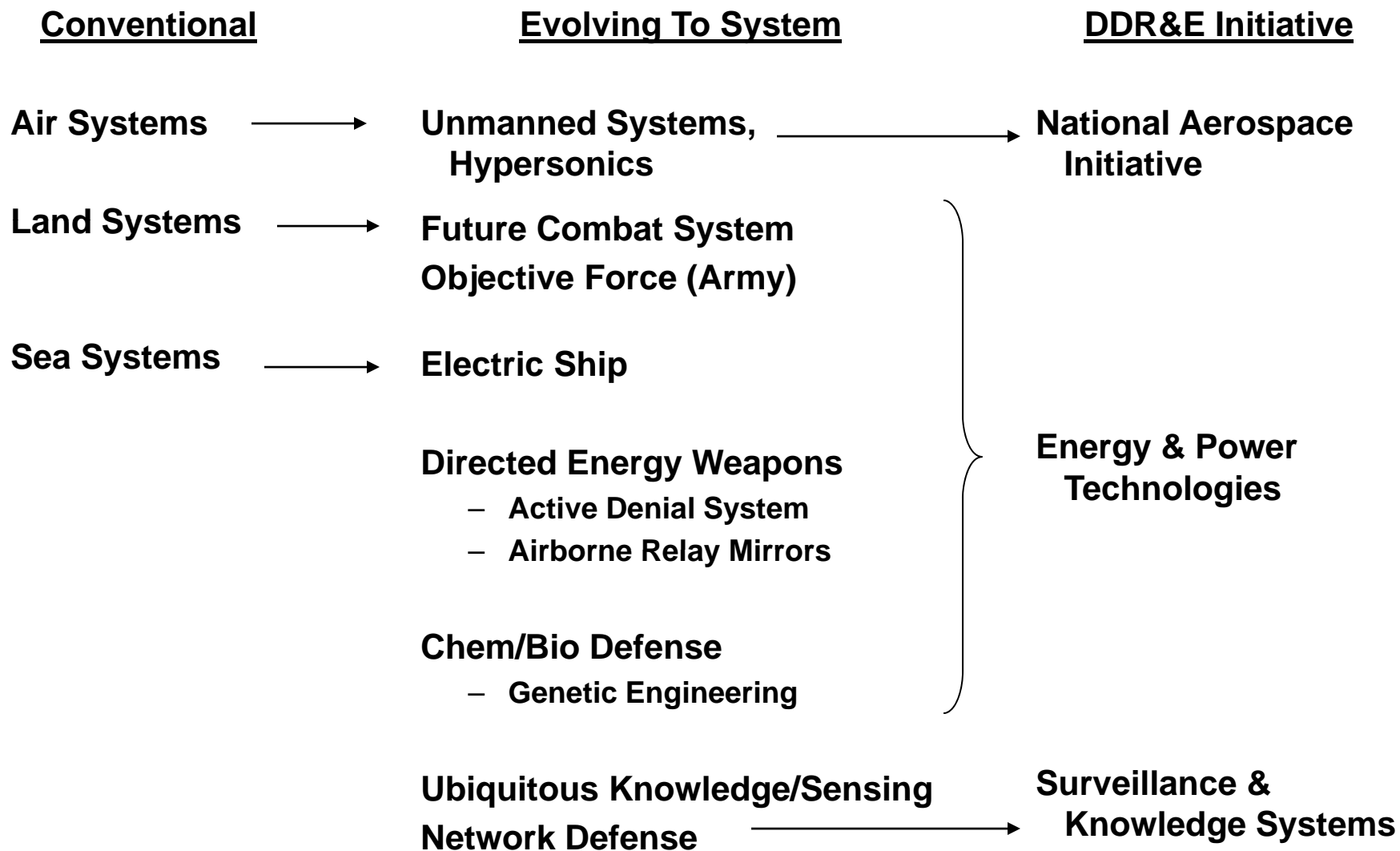
Technology and Transformation

Transformational Attributes



- **DDR&E Transformation Technology Initiatives**
 - **National Aerospace Initiative**
 - **Surveillance and Knowledge Systems**
 - **Energy and Power Technologies**

Traditional Systems Tend to be Mature

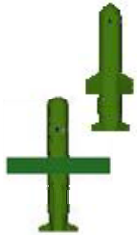


Lethality - Missiles



Non Line-of-Sight Launch System

- Extended Range
- -- PAM >50 km/LAM >100 km
- Increased Loiter / LAM-60 min
- Increased Engagement Capability



NLOS-LS Air & Ground Variants

- Additional Missile Variants
- Networked Missiles
- Improved Affordability

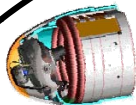
Guidance & Control

- Precision Targeting
- Increased Kill



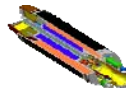
Seeker Technology

- Multimode
- Miniaturization
- Automatic Target Acq



Propulsion Technology

- Increased Velocity
- Longer Range
- Energy Management



Hypersonic Engine

CKEM

- FCS Spiral
- Lethality Overmatch
- 5 ft / 100 lbs
- On-the-Move Capability

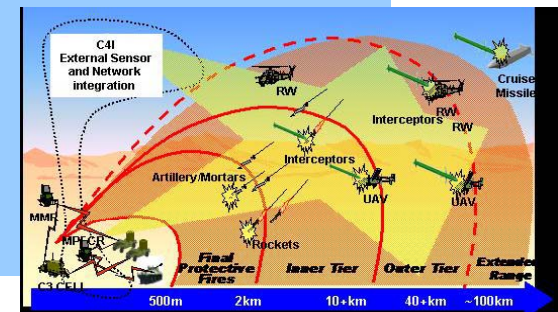


Smaller, Lighter, Cheaper (SLC) Missiles

- Accurate/Maneuverable Urban Weapons
- Lighter/Cheaper Manportable Weapons
- Vehicle, Building & Personnel Targets



Defense Against Rockets, Artillery & Mortars & UAV/CM

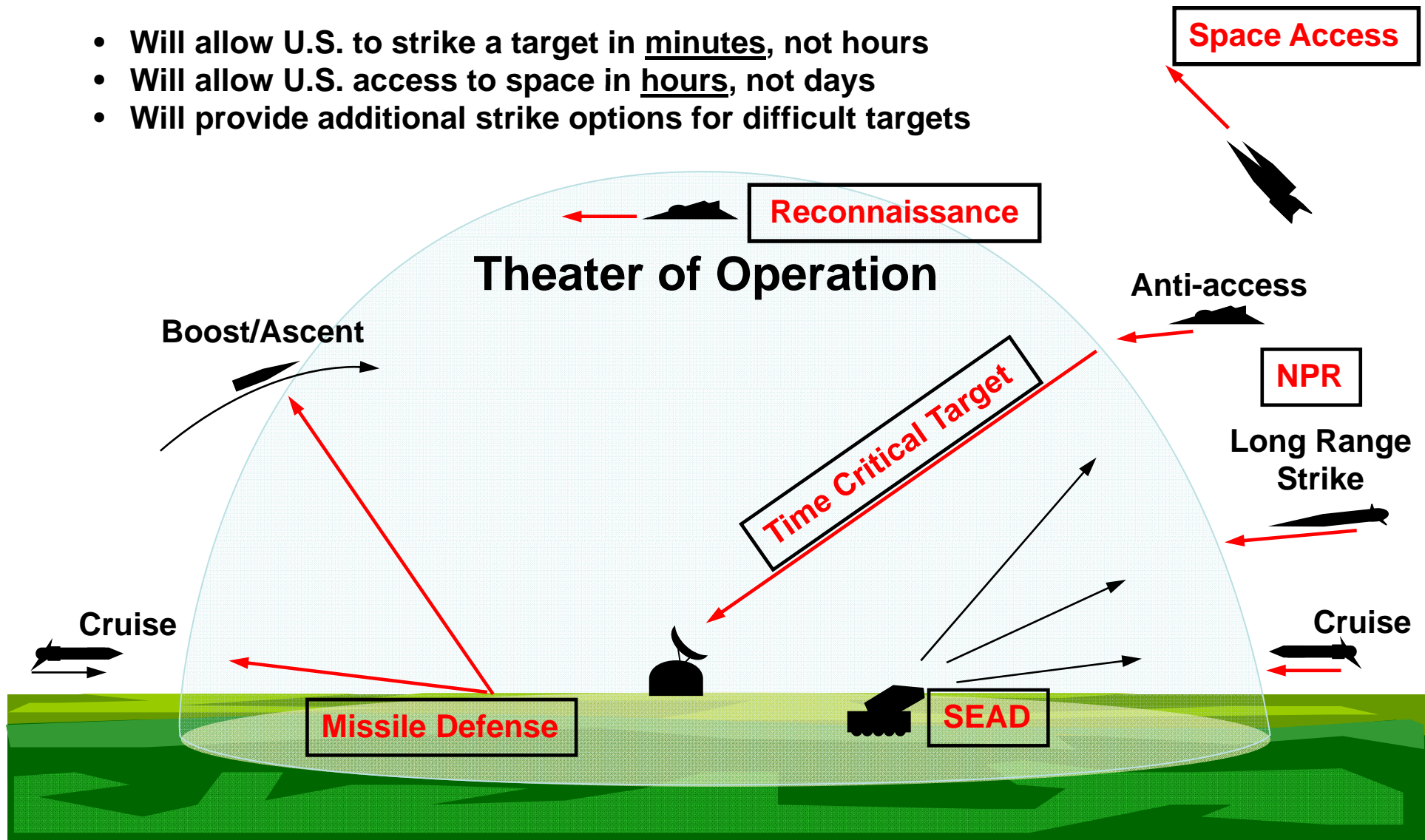


Precision Missiles for FCS/Future Force



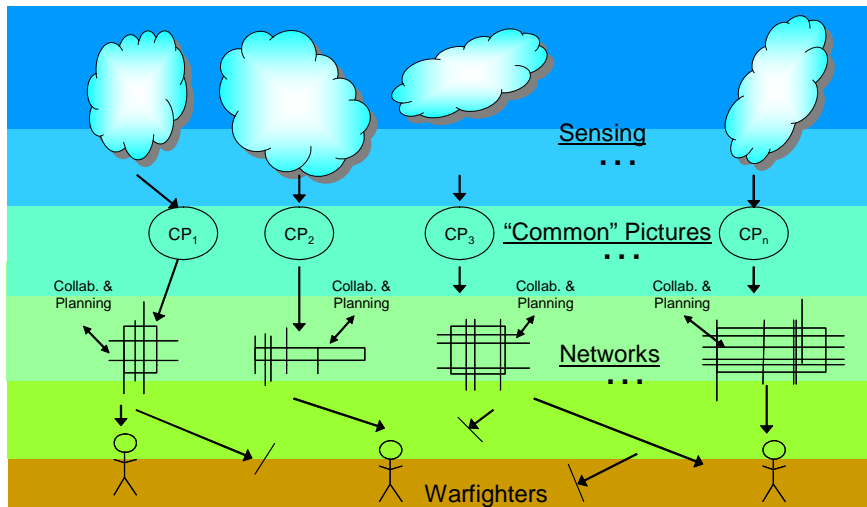
Value of Speed

- Will allow U.S. to strike a target in minutes, not hours
- Will allow U.S. access to space in hours, not days
- Will provide additional strike options for difficult targets

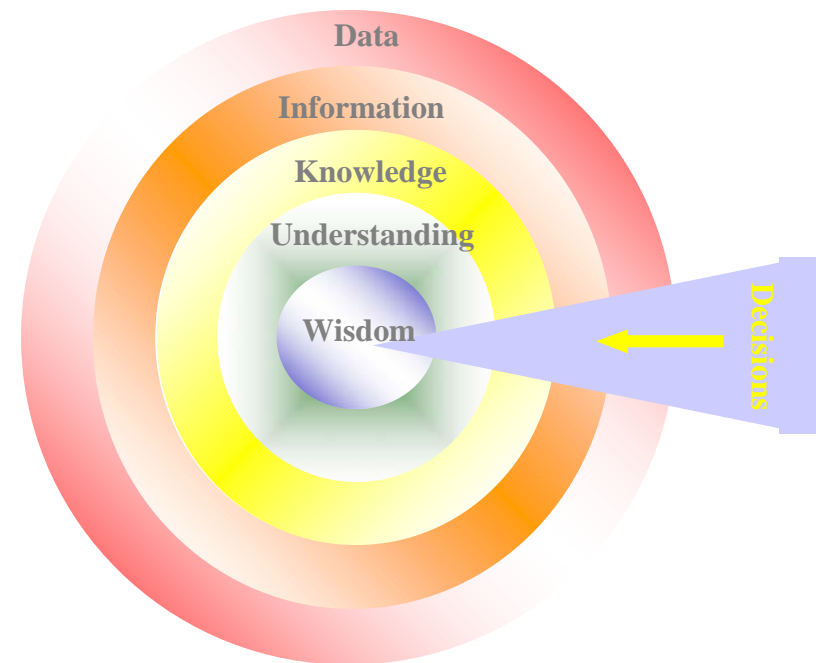
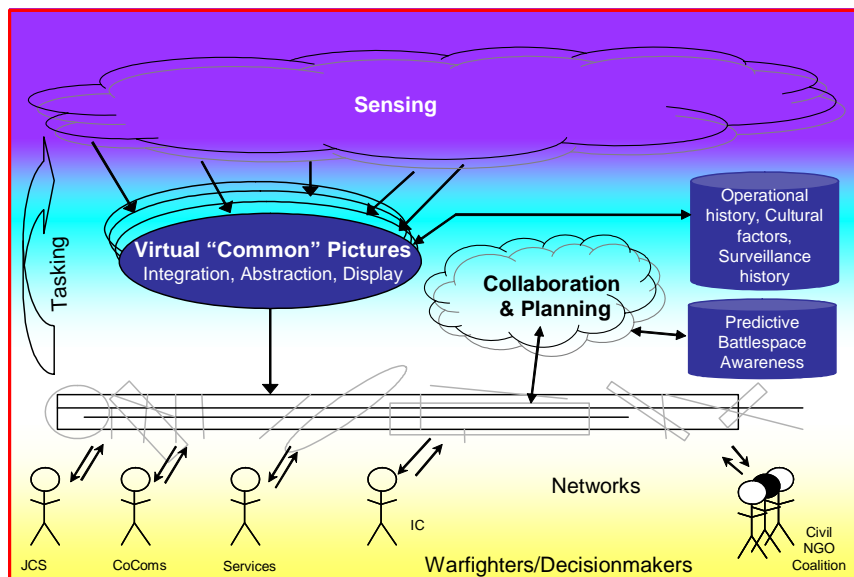


Surveillance and Knowledge Systems

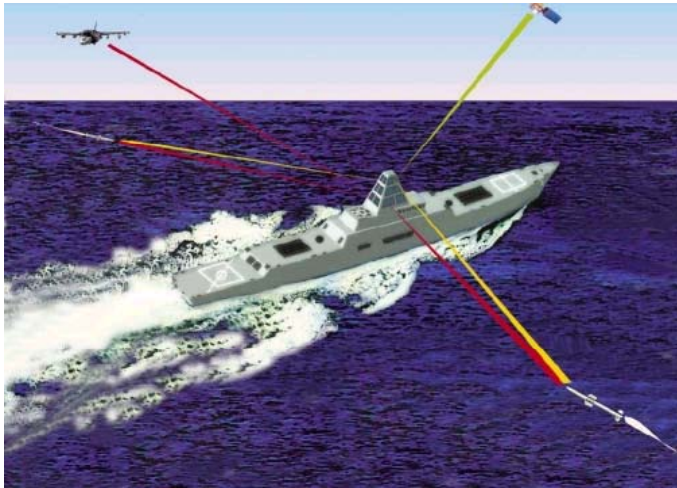
Enabling Integrated C4ISR



- Adaptive Networks
- Ubiquitous Sensors
- Decision Aids

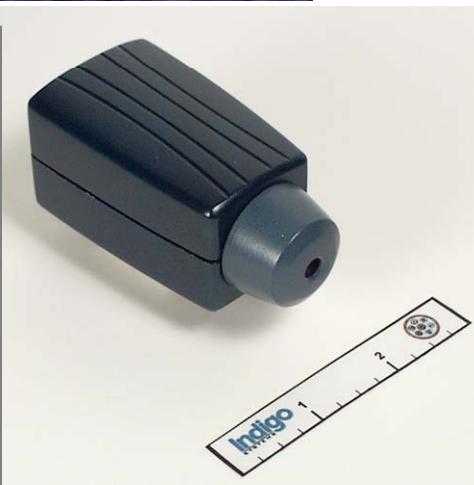
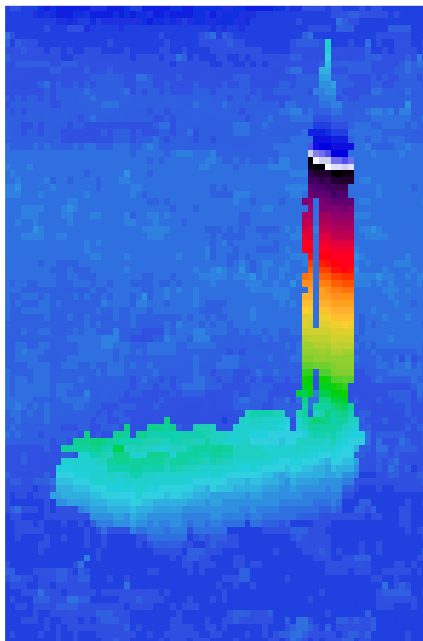


Sensors Are Becoming Part of the System



Some Exciting Initiatives

- Interactive remote sensing: Assisted sensing, laser imaging, 3-D sensors
- Sensor webs & fusion: Smart Sensorweb, proliferable microsensors
- Advanced Multifunction RF System (AMRFS): EW, RF, Radar, Comms
- Microsatellites: Multi-function/mission, cooperative sensor arrays in space.

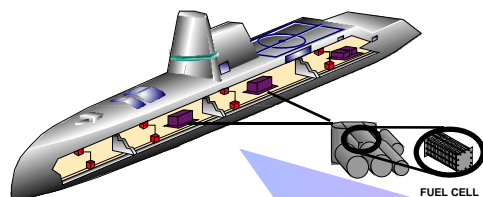


Power Technologies

Pervasive & Enabling



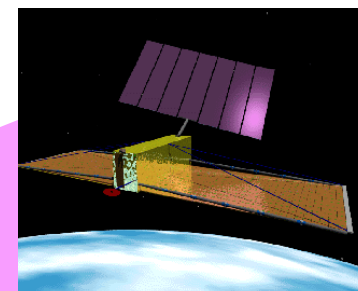
POWER GENERATION
<ul style="list-style-type: none">• Fuel Cells & Fuel Reforming• Novel Power
ENERGY STORAGE
<ul style="list-style-type: none">• Batteries• Capacitors
POWER CONTROL AND DISTRIBUTION
<ul style="list-style-type: none">• Switching & Conditioning• Power Transmission & Distribution• Thermal Management



Electric Warship

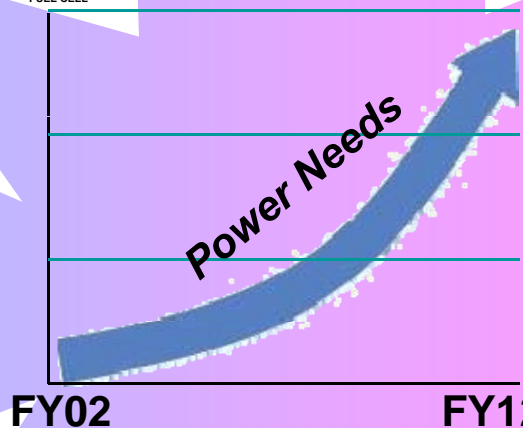


More Electric Aircraft



Space Based Radar

High Power Microwave



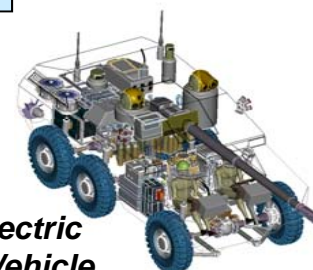
New Operational Capabilities



Warrior



Electric/Hybrid Weapons



Hybrid/Electric Combat Vehicle

HIGH ENERGY LASERS

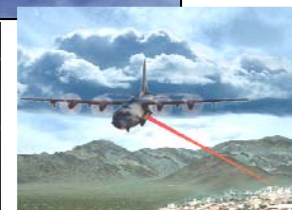
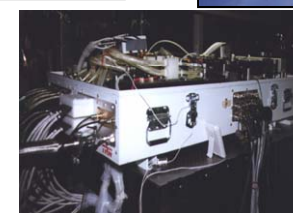


Electric High Energy Laser Pulses Can:

- Cause thermo-mechanical damage
- Provide graduated lethality
- Offer low cost per kill

Applications/Missions:

- Illumination and range finding
- Ground and aircraft-based weapon
- Air and missile defense
- Ship self-defense



Required Technologies:

- 2X more power efficient diode packages
- 100X increased diode package reliability
- 10X higher individual slab/rod/fiber power levels
- Beam combining techniques
- Improved thermal management (10X lower weight)
- Weight efficient power conditioning (pulsed & CW) [10X lower weight]

Warfighter Payoff

- Greatly reduced logistic needs (gal's of JP-4 vs \$1M missile)
- Increased Lethality against:
 - Boosting TBMs
 - Maneuvering Threats
 - Swarm Threats
 - Threats in close proximity to noncombatants

High Power Microwave (HPM) Weapons



High Power Radio Frequency/Microwave Pulses that can:

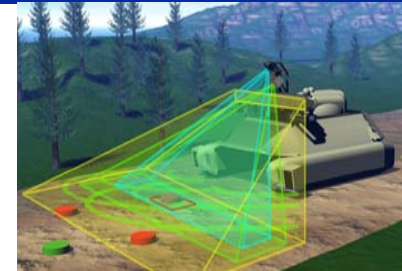
- Upset and/or Damage Electronics
- Produce Non-Lethal Effects on Personnel
- Floods Target Area - High P_{hit}
- Rheostatic Target Effect (Temporary to Permanent)

Applications/Missions:

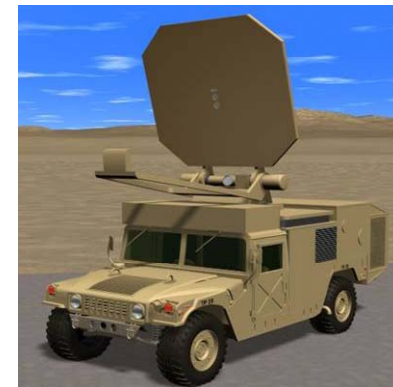
- Counter Command and Control/Infrastructure, etc.
- Vehicle/Platform Protection (Counter Mines/ Munitions)
- Anti-Personnel/Area Denial/Crowd Control
- Air/Missile Defense

Required Technologies:

- 75% Smaller High Power/Gain Antennas
- Effects/Sources Modeling and Simulation
- Pulse Power for Mobile Platforms
 - 2X Operating Voltage for Pulsed Switches
 - 4X Energy Density for Capacitors
 - 2X Operative Voltage for Power Distribution Cables



Counter mines/munitions



Counter personnel (non-lethal-to-lethal)

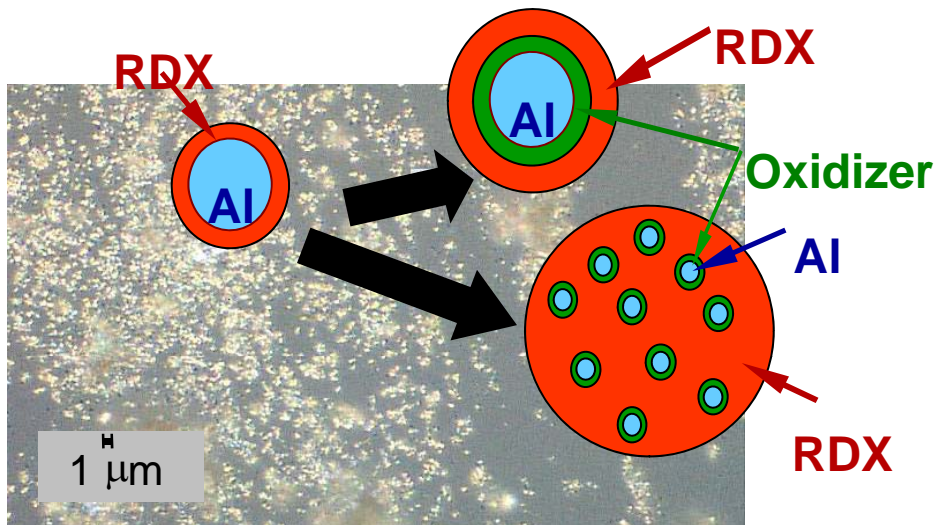
Warfighter Payoff

- 40% system weight reduction
- 90% system volume reduction
- Low collateral damage
- Greatly reduced logistics



Nano Energetics Example

Potential Payoff in Revolutionary Explosives

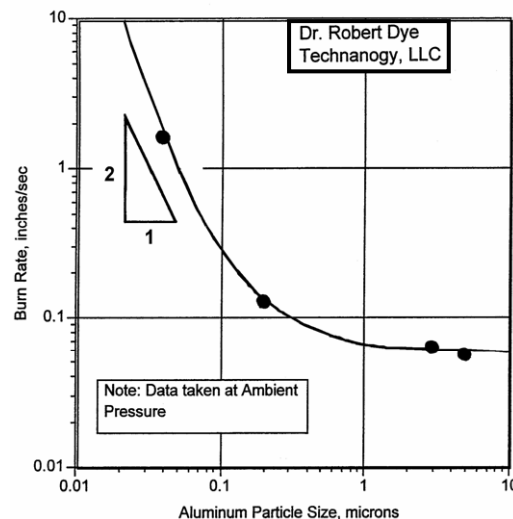


Nanoscale Aluminum, Coated by RDX

Nano fuel particles coated by oxidizer

- 100x power – increase in energy release rate
- 2x total energy – greater surface and internal volume free energy available
- 10x efficiency – near 100% complete reactions
- 10x safer – lower sensitivity to mechanical initiation
- More compact - no binder

Burn Rate vs. Particle Size



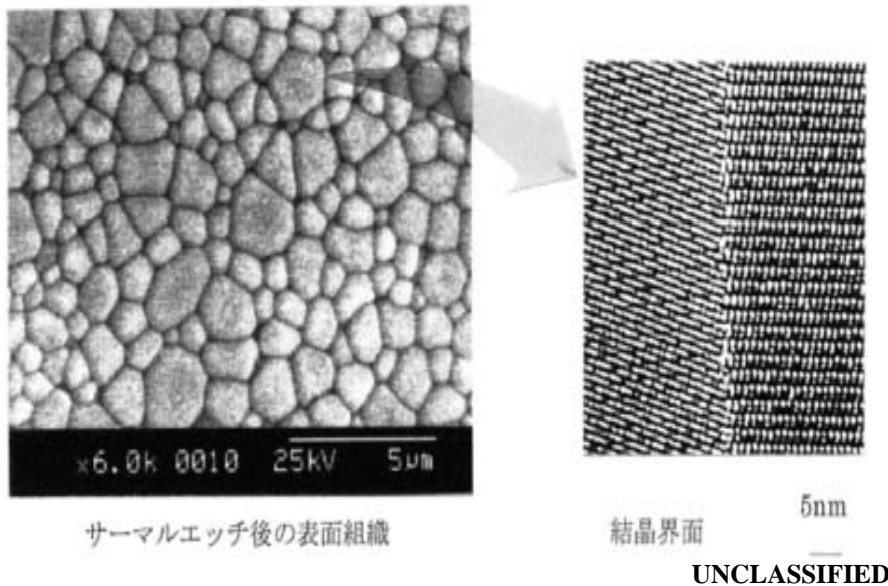
Payoff to the Warfighter

- Smaller, safer munitions
- More kills per event
- Decreased logistics tail
- Enables small, weaponized UAVs



Foreign Example

Nanocrystalline / Nanostructured materials



Developed by Konoshima Chemical Co

PLM - higher strength & toughness;
Larger sizes; Currently 20% less expensive

Technology can be applied to :

- Transparent armor
- Electromagnetic windows
- IR dome materials
- Sensor windows
- X-ray scintillator materials

- Japanese novel patented process to produce YAG nanoparticles

- Liquid-phase chemical reaction
- No pressure required, low temp.
- 100 nm average diameter
- Largely homogeneous



The Future

- **Office of the Director, Defense Research and Engineering asked to study Disruptive Technologies**
 - Will impact Quadrennial Defense Review formulation
 - Probable FY06 start-up initiative
- **Disruptive Technologies are uncertain**
 - Final use may not be predictable
 - Need to “seed” lots of efforts
- **Seeking help looking to the future**



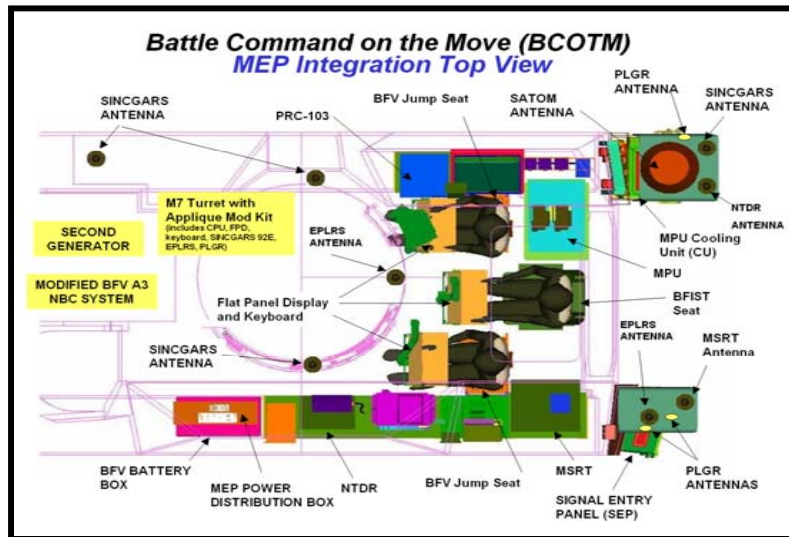
Disruptive Technology Example: National Aerospace Initiative



Disruptive Technology Example: Surveillance & Knowledge Systems



Example of Impact in OIF



Battle Command on the Move (BCOTM)

In support of PM-Platforms and PM-Bradley, CERDEC designed and developed the Mission Equipment Package (MEP) installation for the BCOTM platform for the 4th ID. The installation integrated the BFA Computer Systems (AFATDS, AMDWS, FBCB2, MCS, ASAS) into a C2 system that provides near real-time battlefield information focused on intelligence, effects and maneuver. Five M7 Bradley vehicles were modified and delivered to the 4th ID within 40 days of project initiation. They are currently deployed for use in OIF, providing the battlefield commander the unique capability of maintaining situational awareness and effectively executing battle command tasks while on-the-move and not tethered to his Command Post.

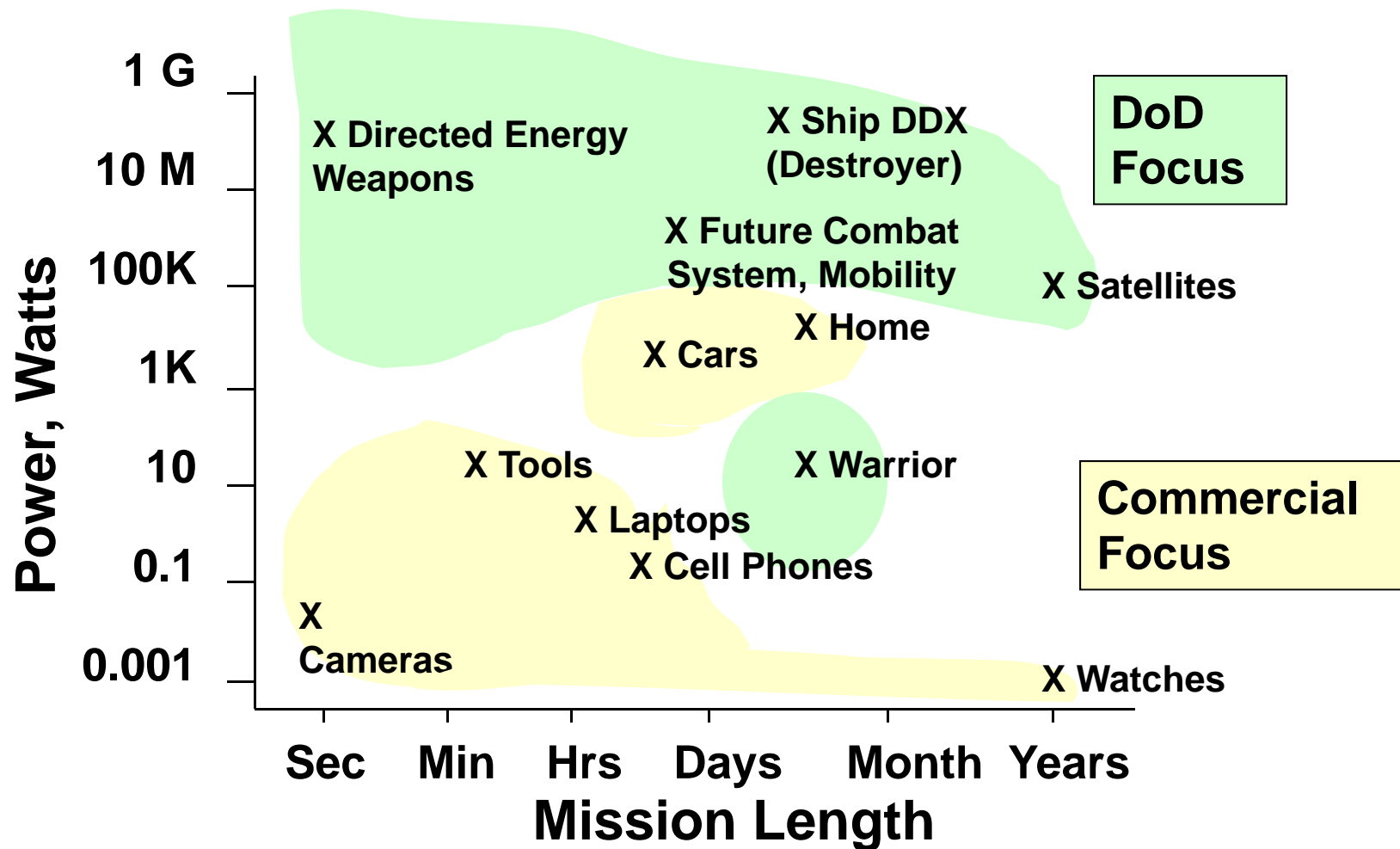


Freeing the Commander from the Fixed Command Post



Disruptive Technology Example: Energy & Power Technologies

Energy and Power Technologies





The Objective Force Army

Today



~100 lb.
load



70+
tons



0
mph

*From Platforms to
System of Systems*



*C-130-Like
Transportability*

Future Force

< 40 lb.
effective
load



Fully networked

< 20
tons



> 40
mph



Accelerating Transformational Capabilities